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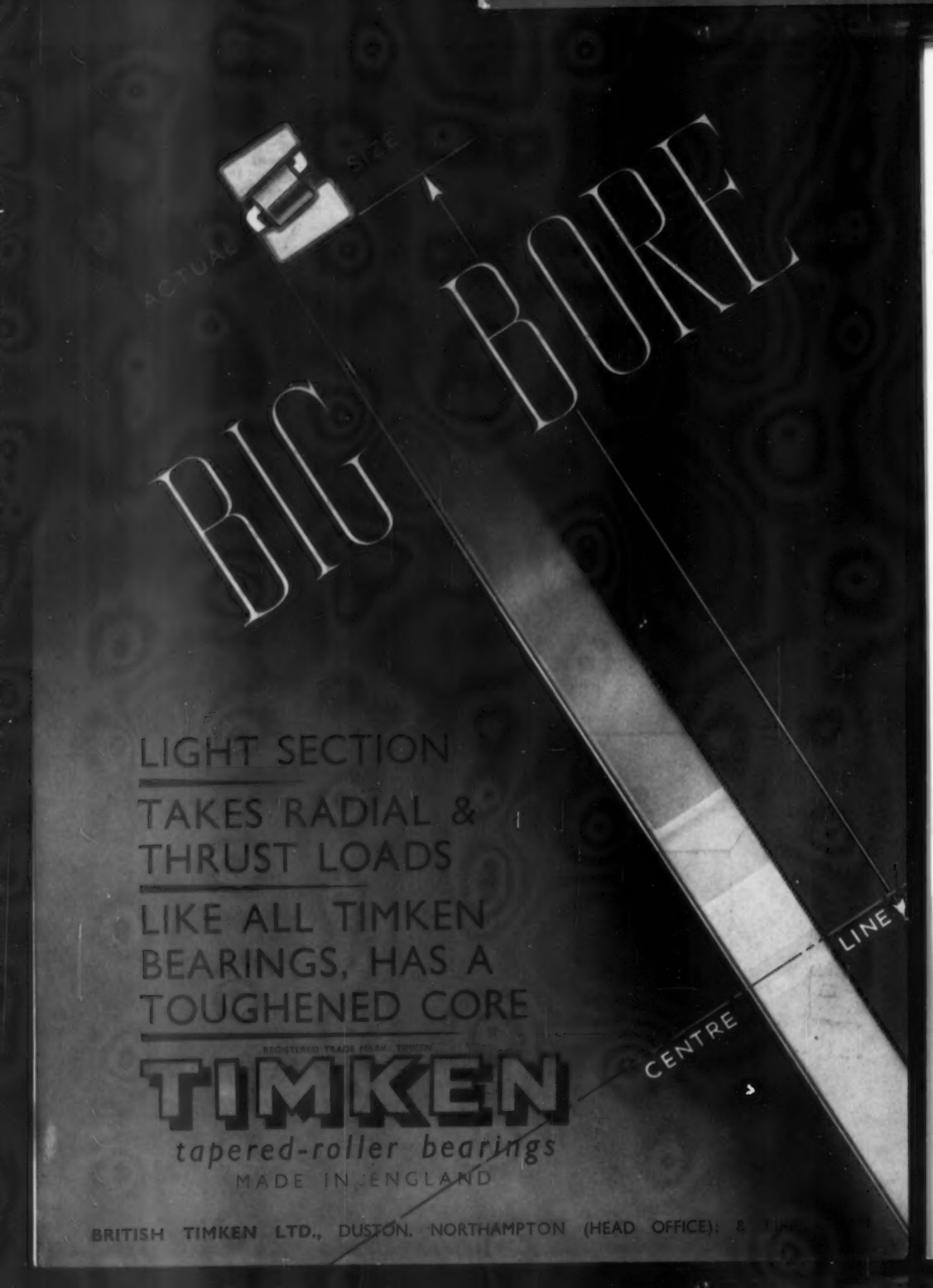
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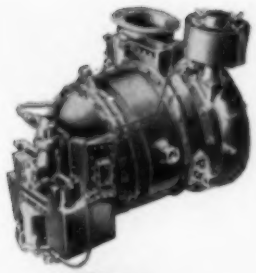

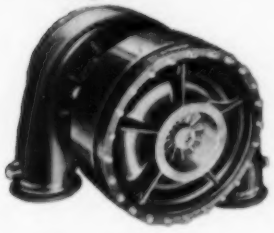

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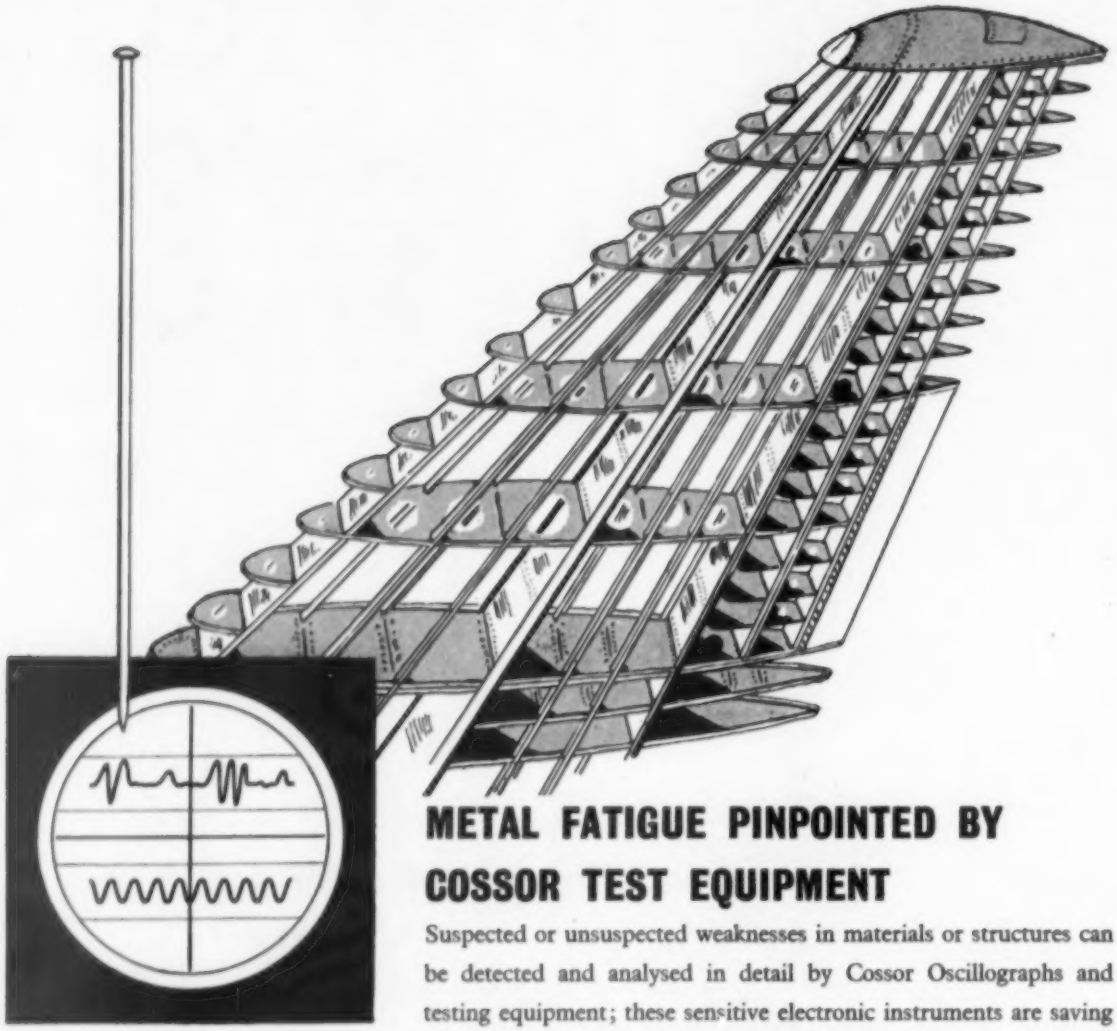

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a *Investigation of fatigue behaviour in aircraft structural components is carried out with this pulsator. Steady tensile loads of up to 20 tons per sq. in. may be applied to which can be added oscillatory stresses of up to 10 tons per sq. in. The Cossor Oscillograph displays the output of the exploring strain gauges. Photograph by courtesy of* **Saunders-Roe Ltd.**

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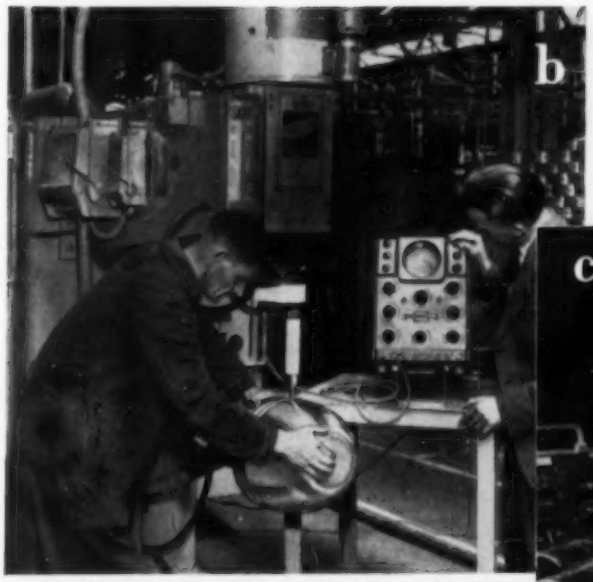
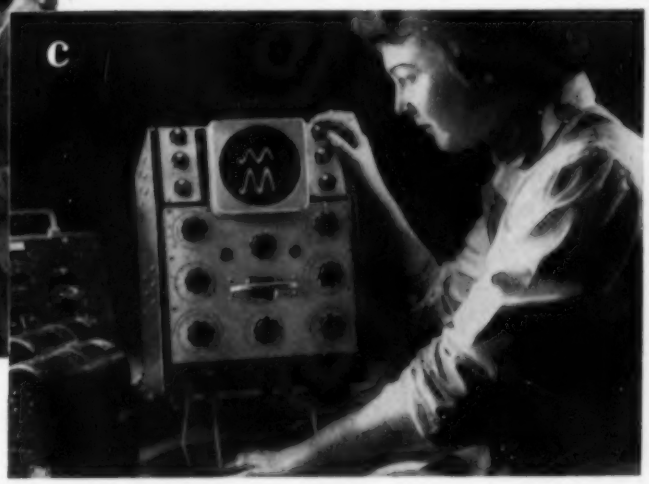
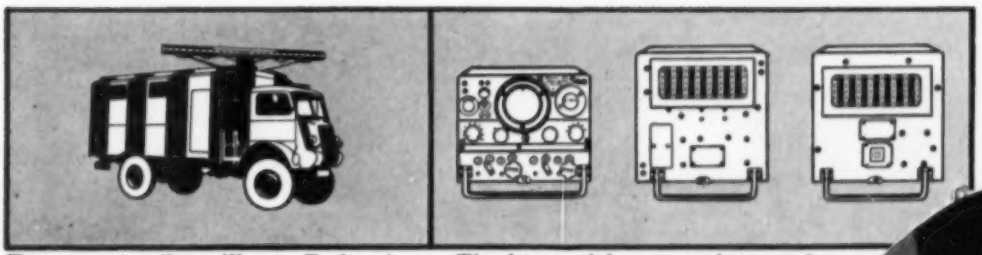


b *The Cossor Model* 1049 *Double Beam Oscillograph is displaying the onload waveform of the welding current through a starter fairing of a Rolls-Royce "Avon" engine. Photograph by courtesy of* **Rolls-Royce Ltd.**



c *The Cossor Model* 1049 *Double Beam Oscillograph displays the output of the twin inverters under test at the works of Sir W. G. Armstrong Whitworth Aircraft Ltd. Photograph by courtesy of* **Sir W. G. Armstrong Whitworth Aircraft Ltd.**



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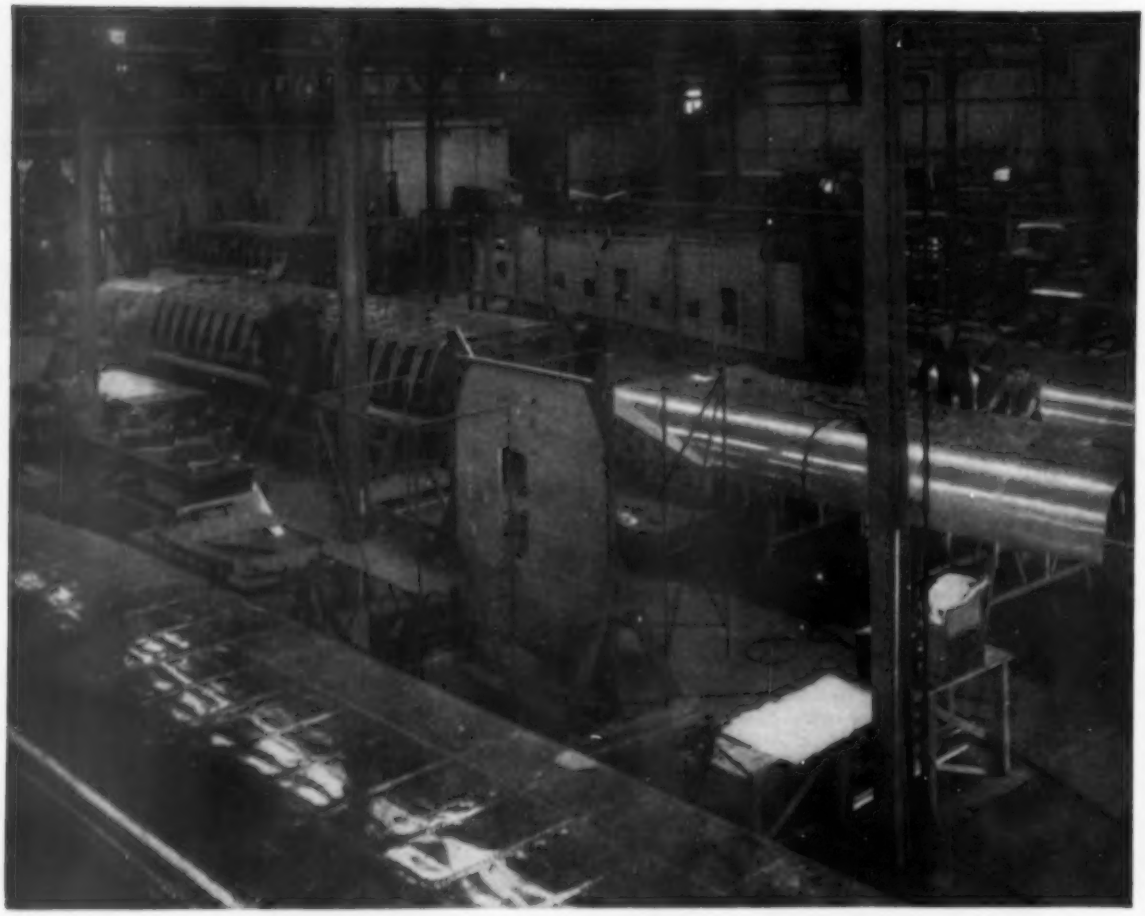

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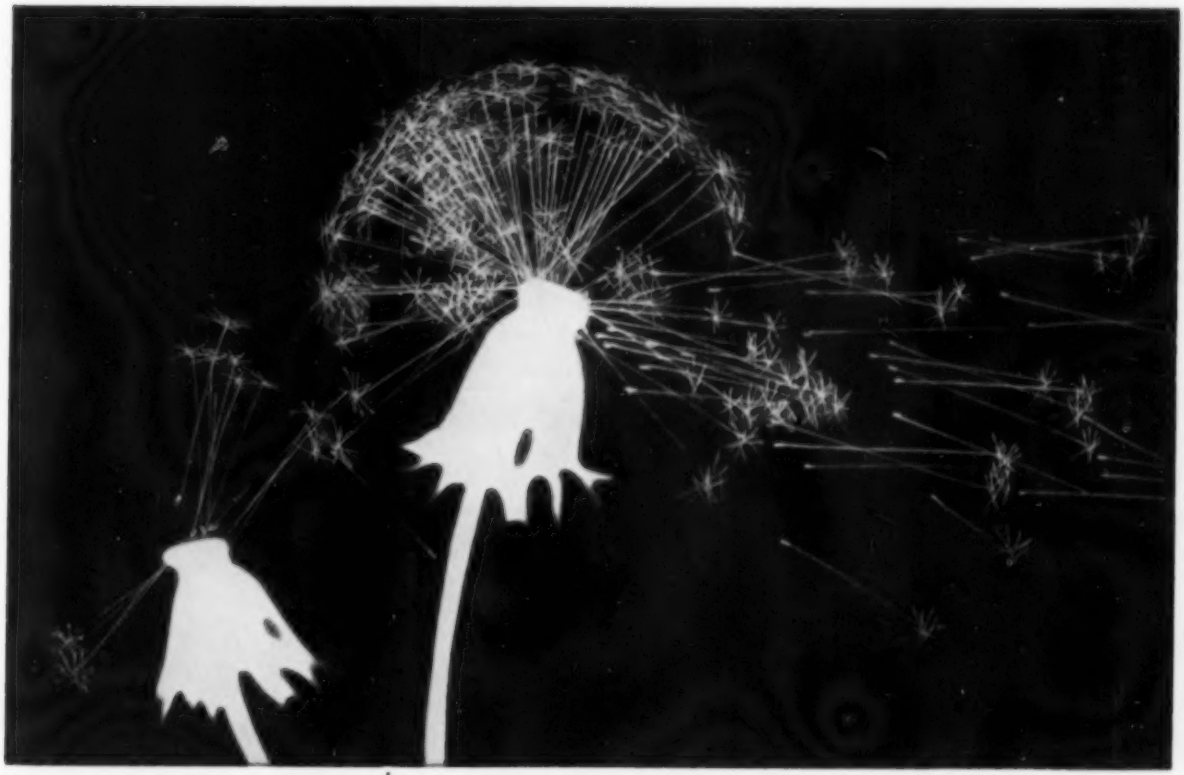

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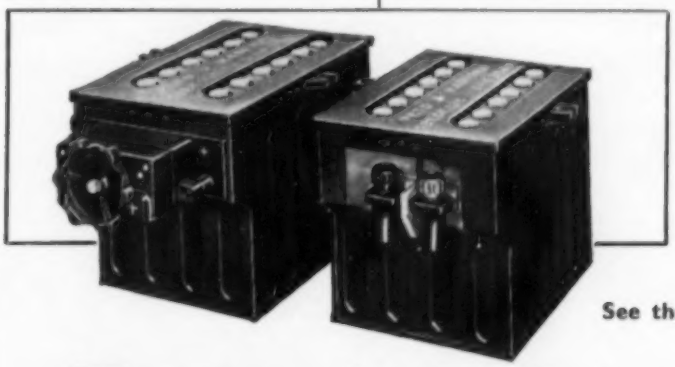

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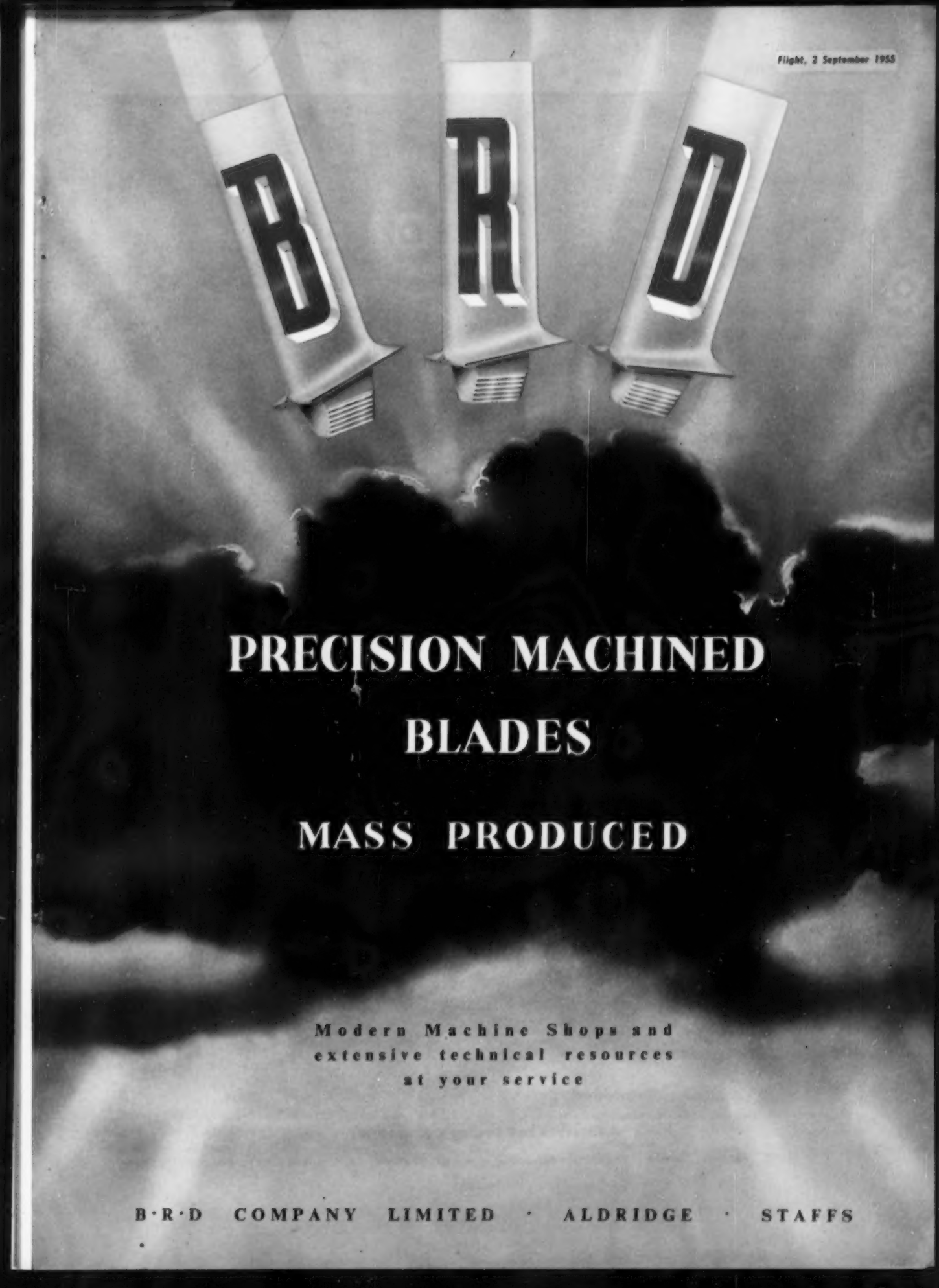

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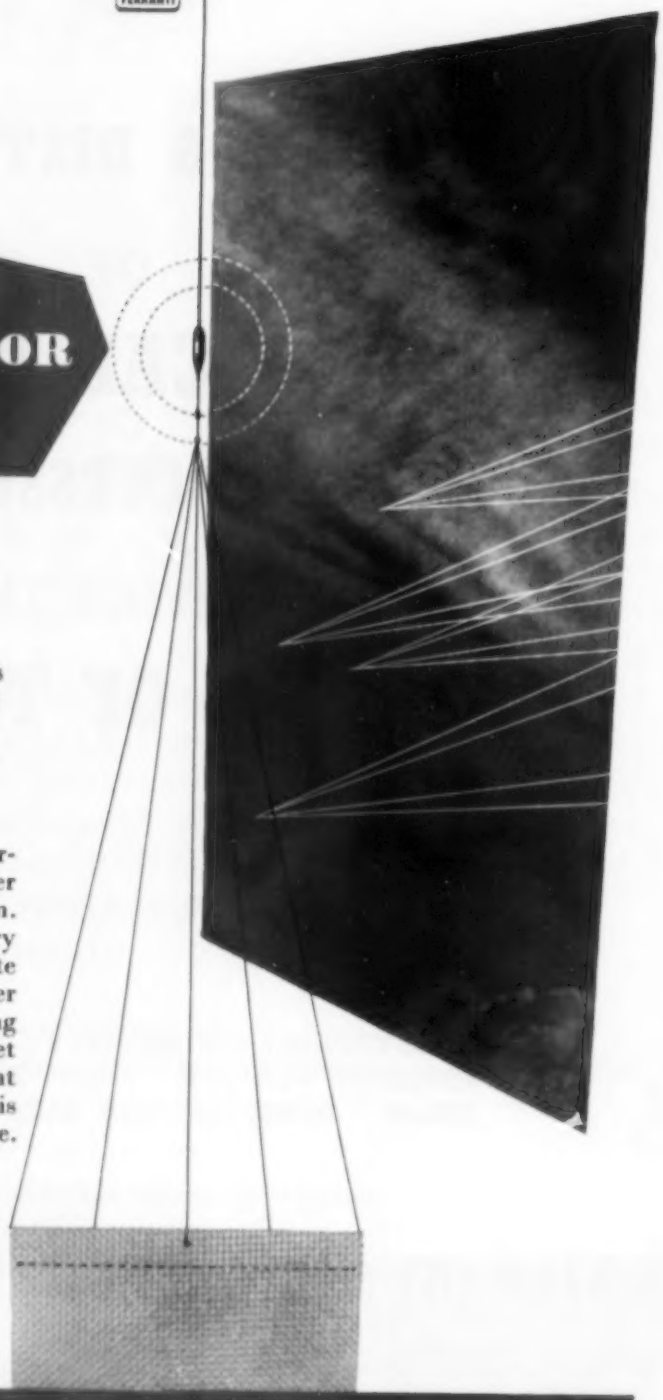

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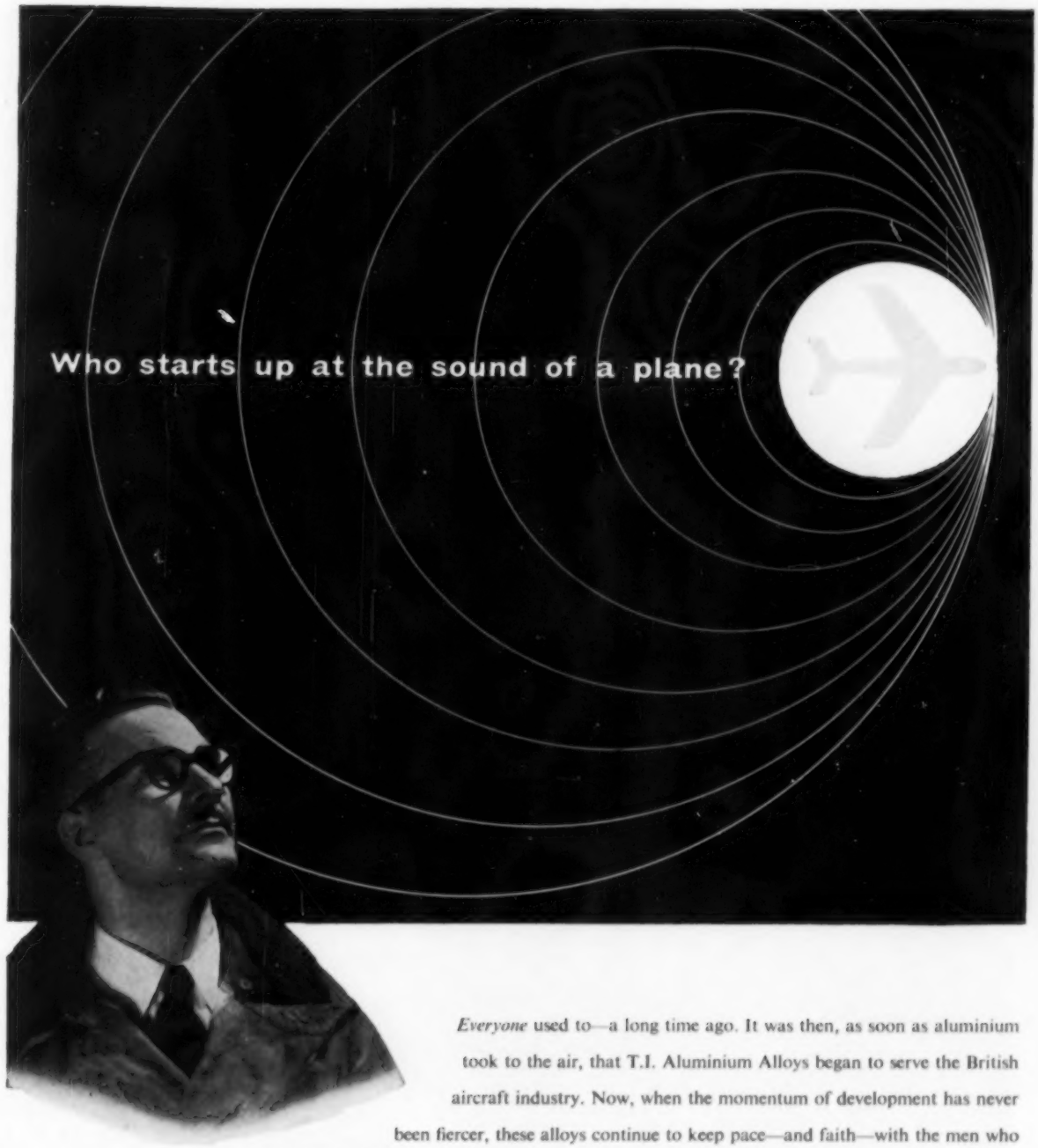

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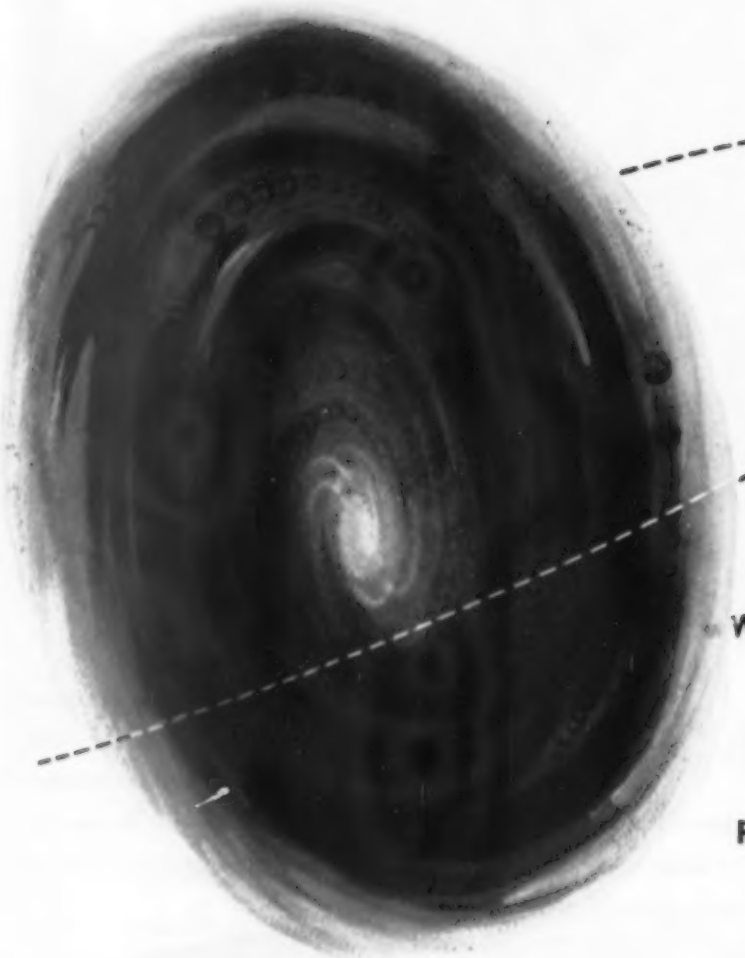

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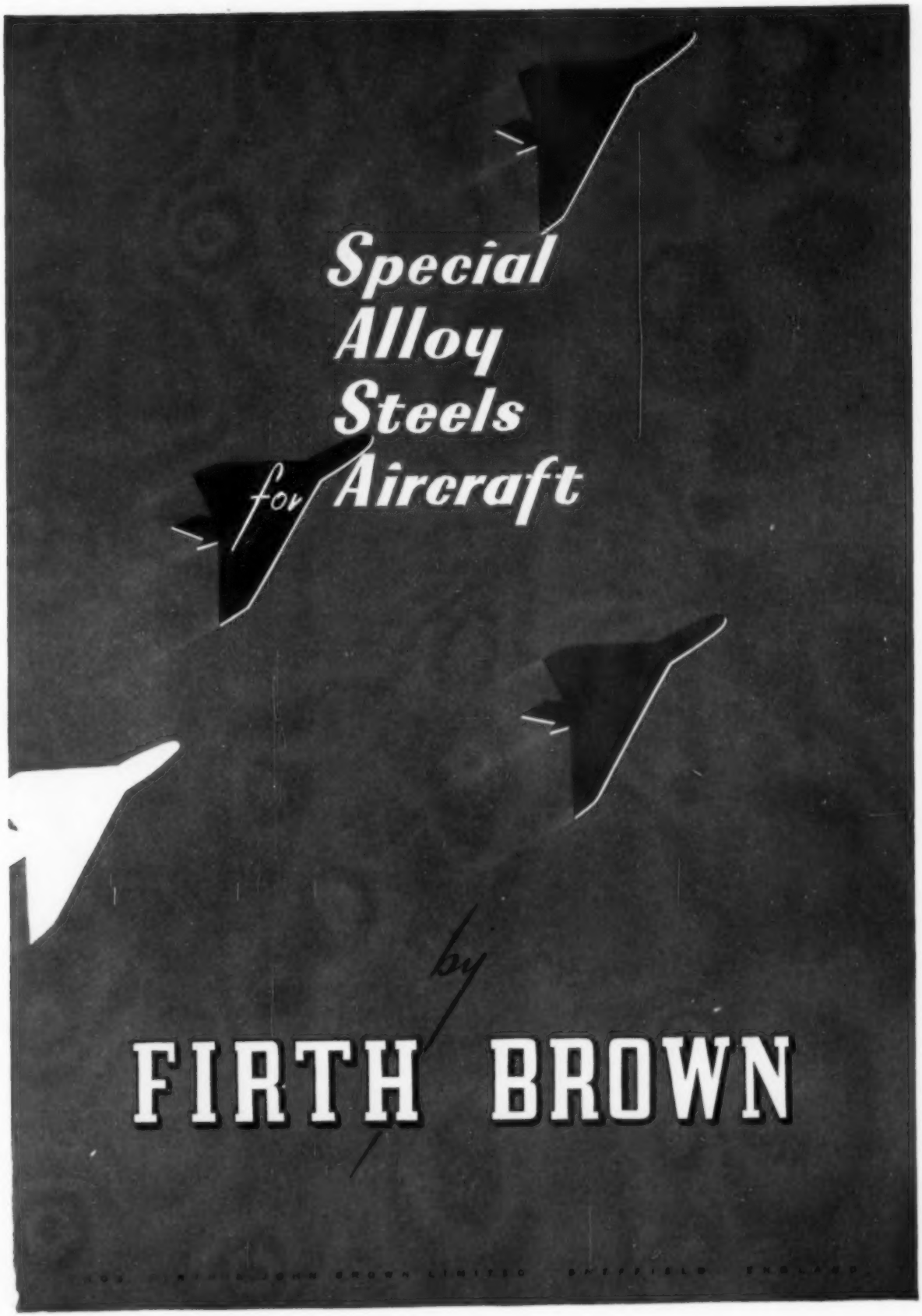
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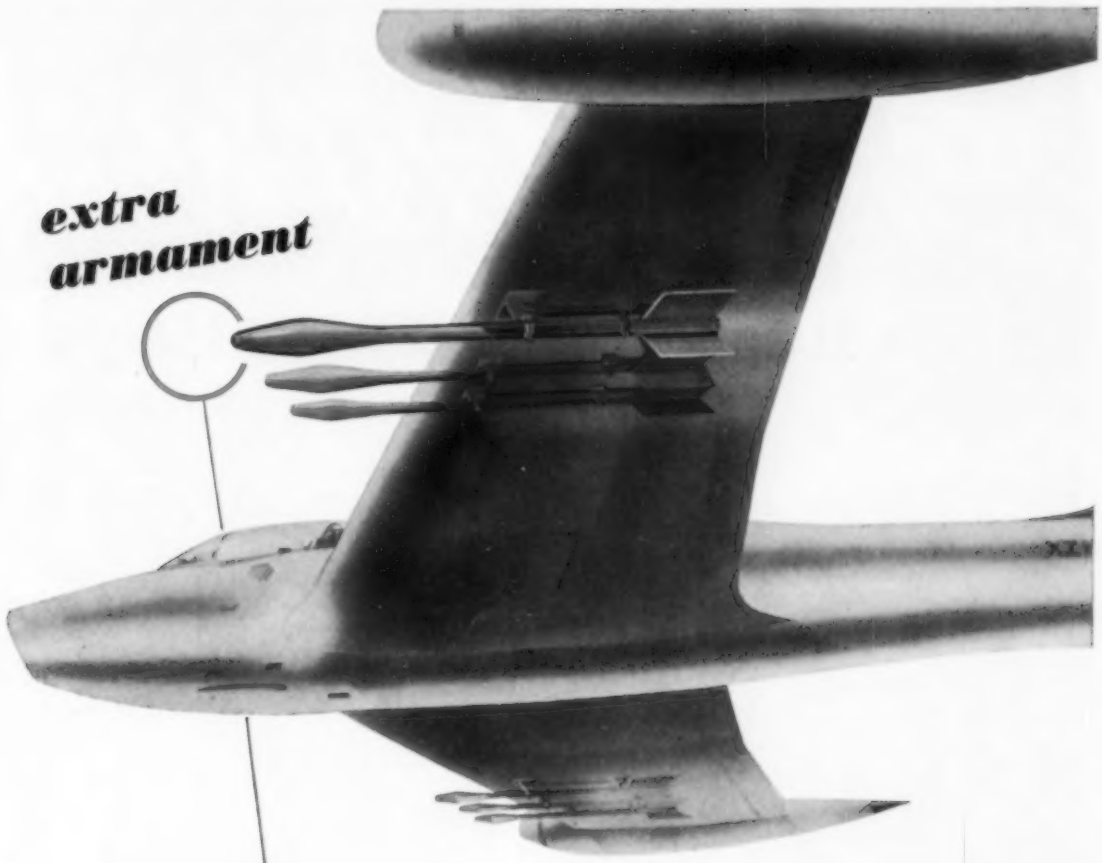

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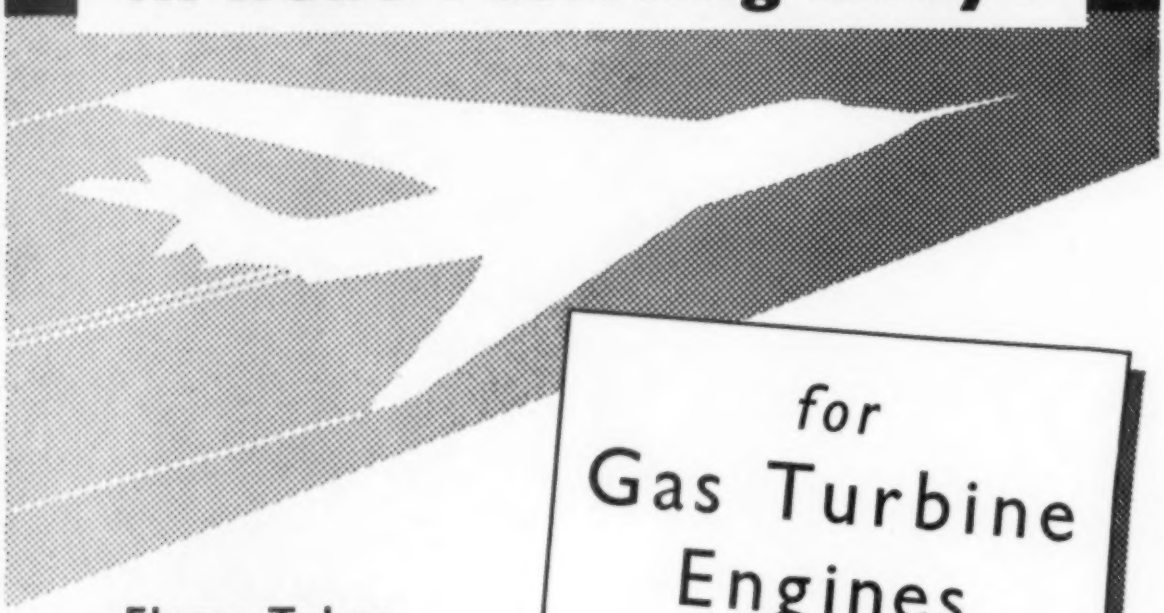

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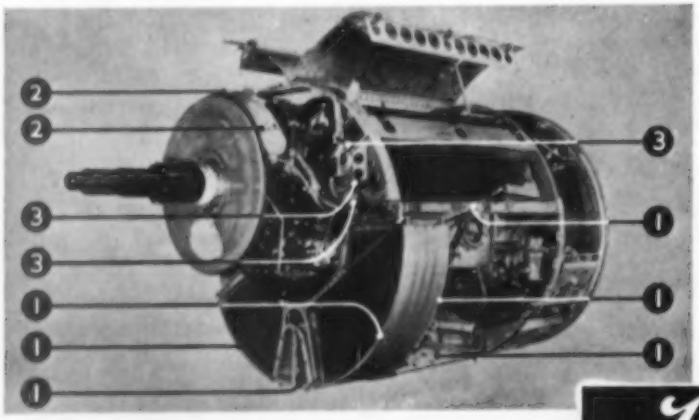

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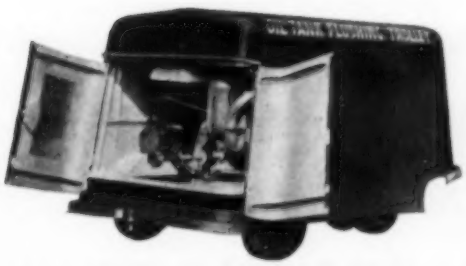

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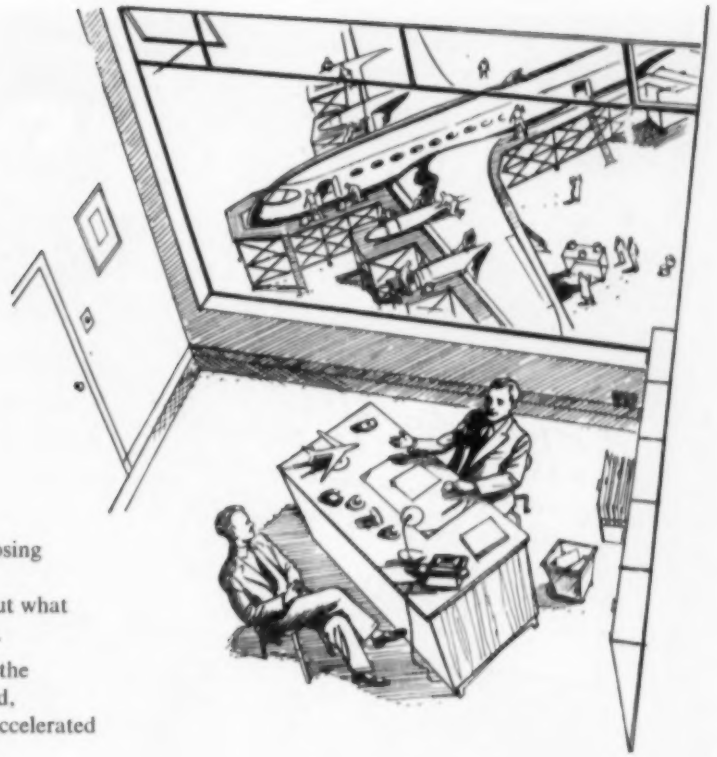

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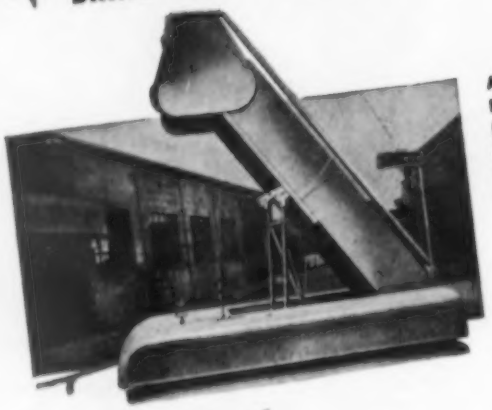

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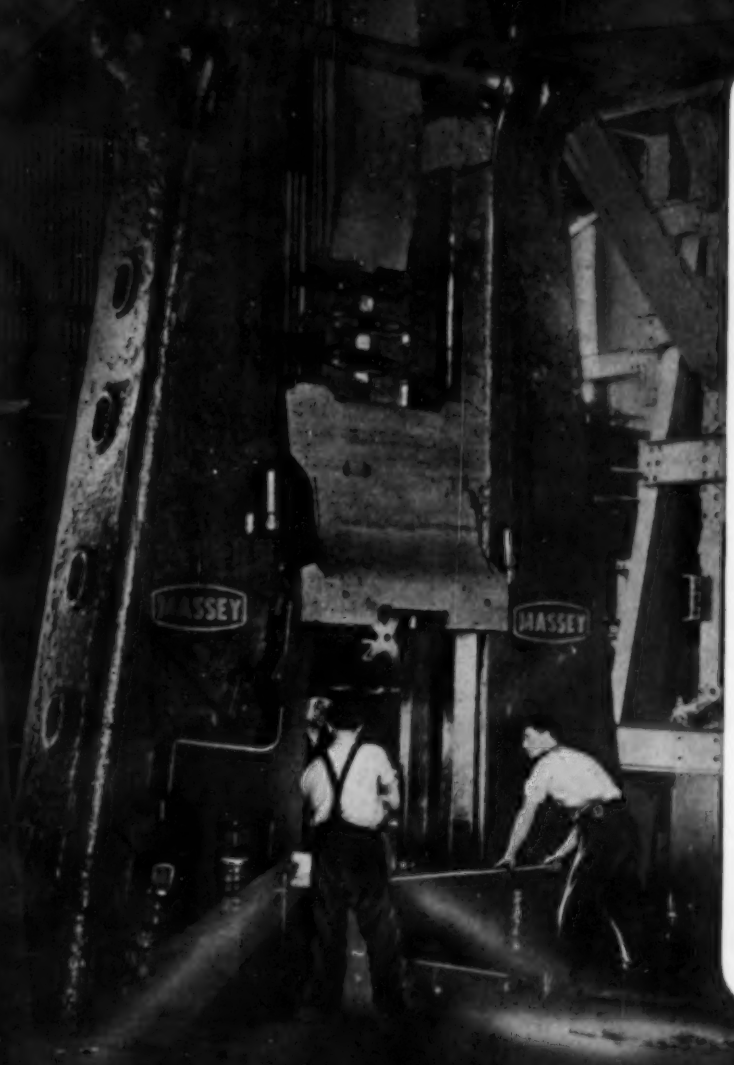

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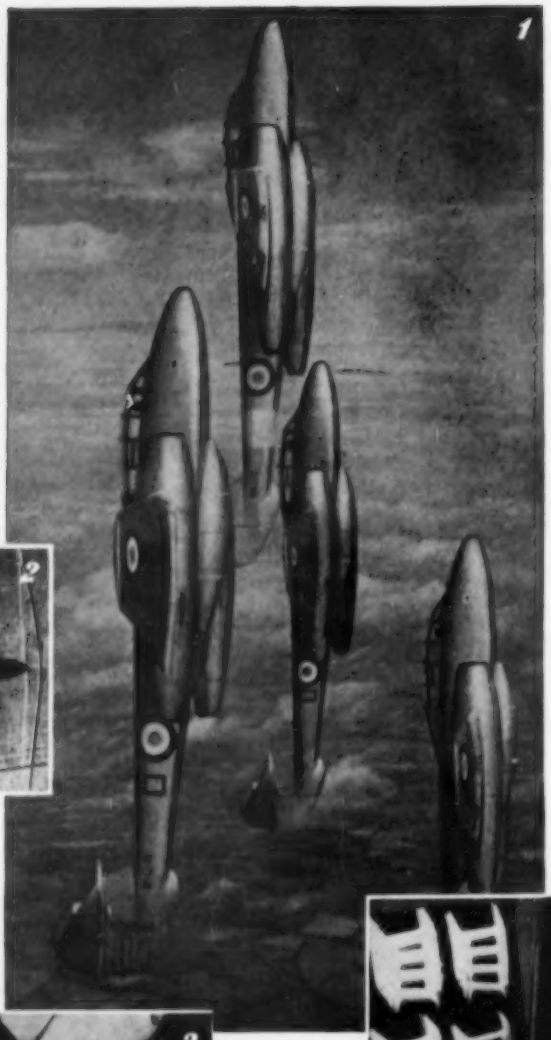

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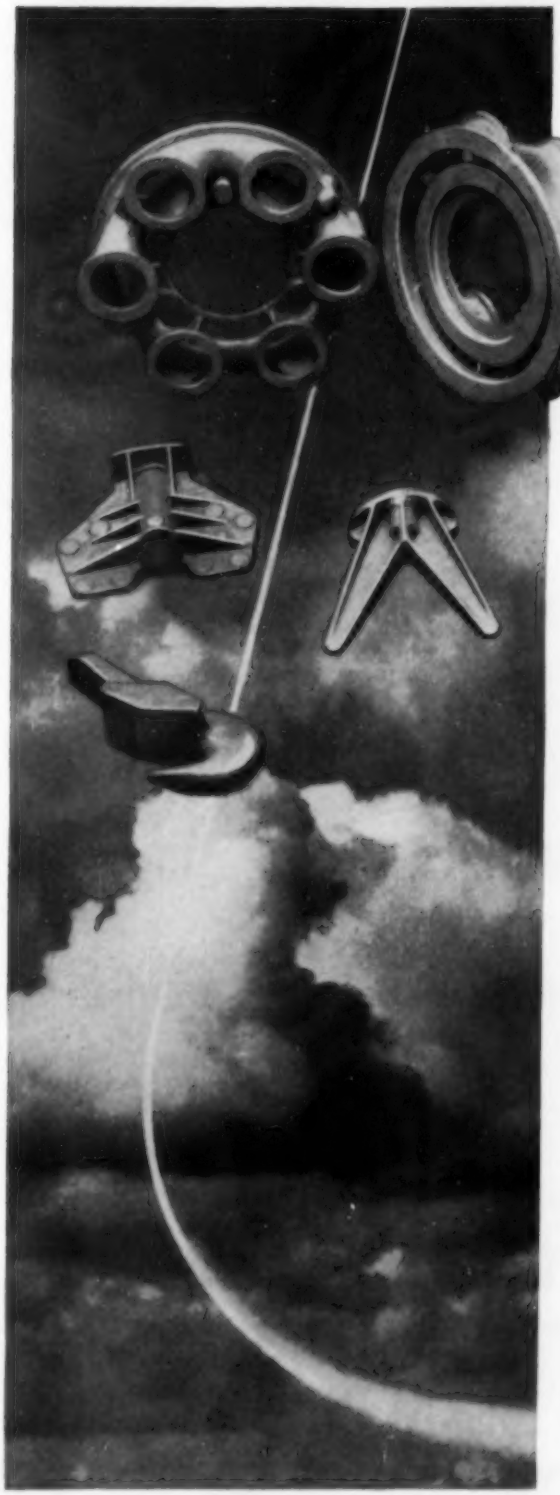

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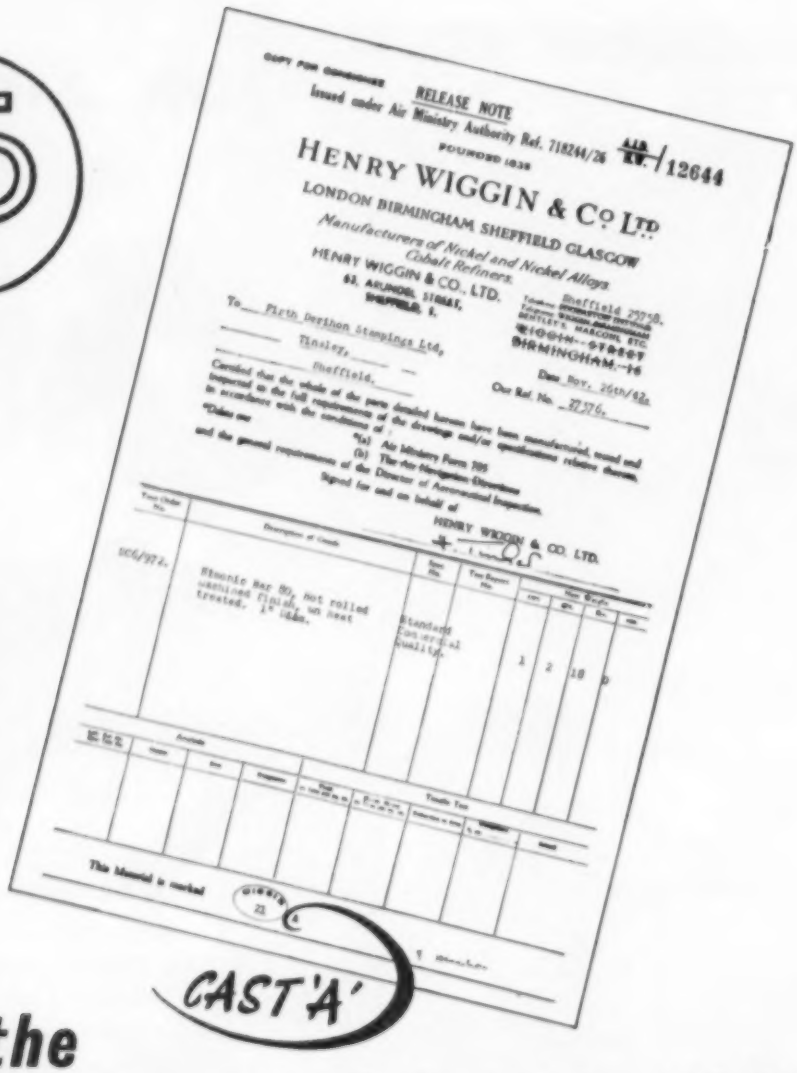
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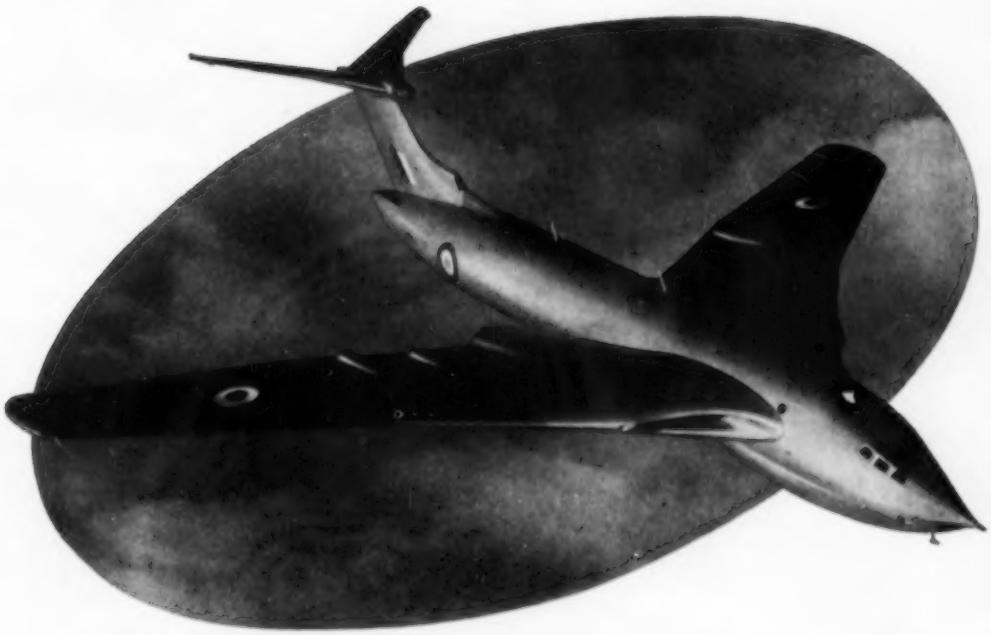

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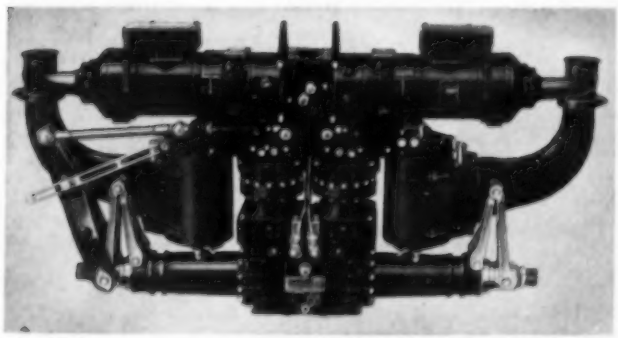

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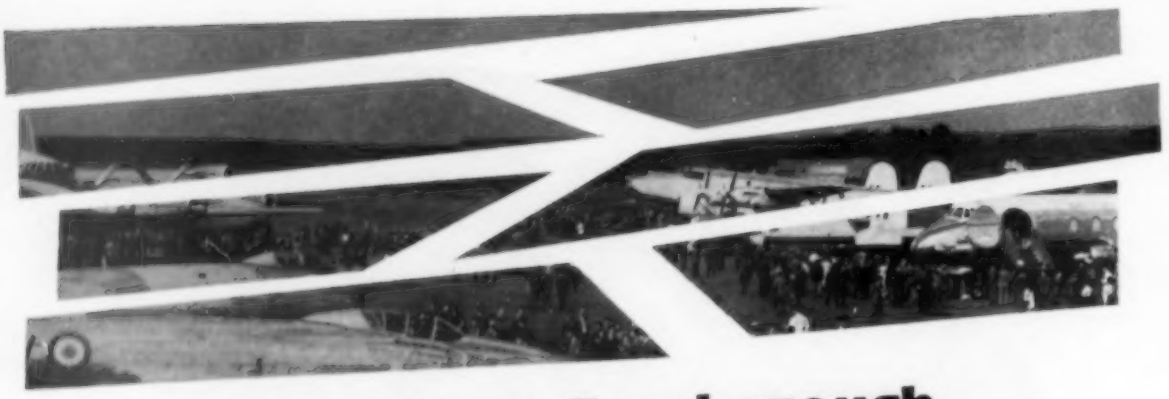

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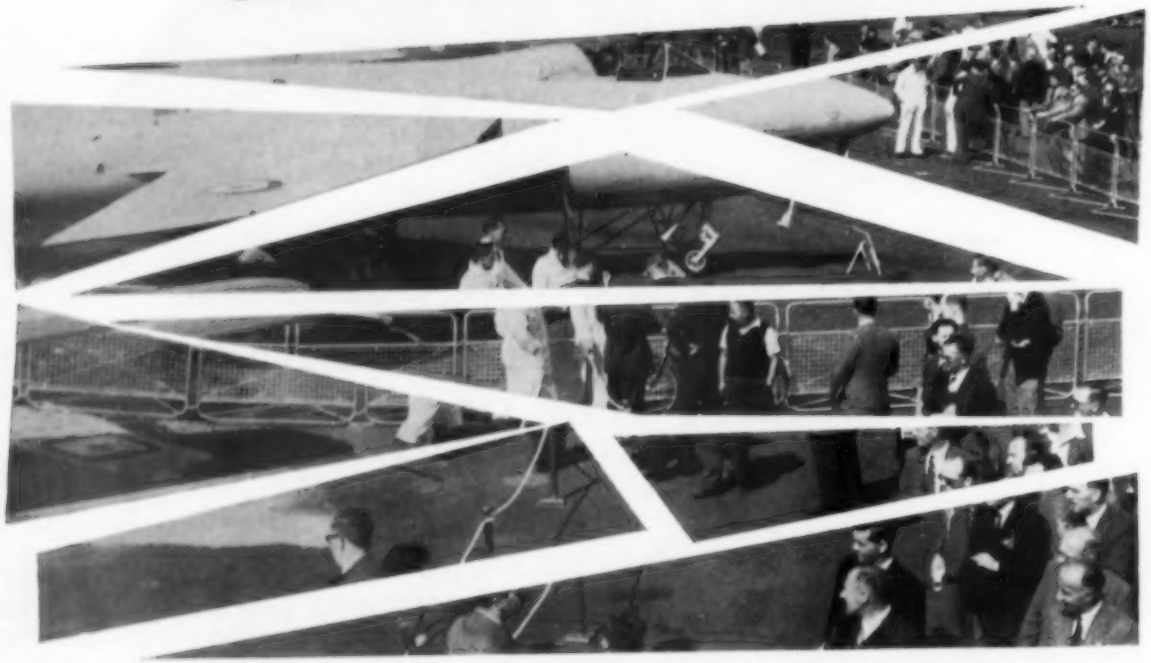

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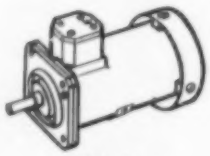

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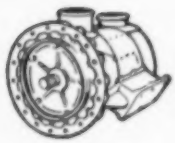

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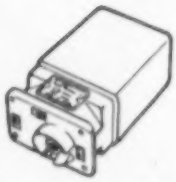

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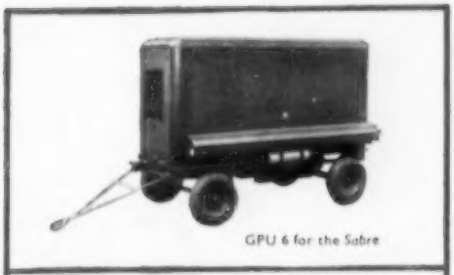

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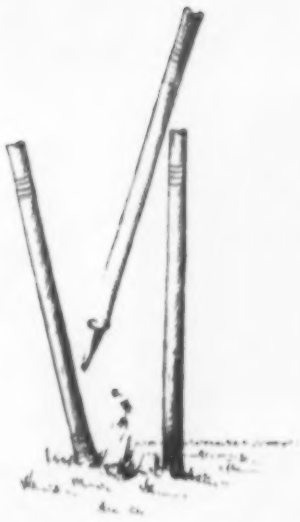

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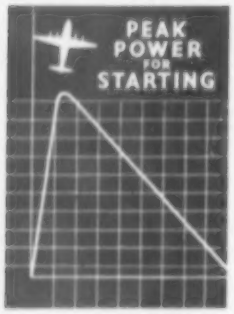

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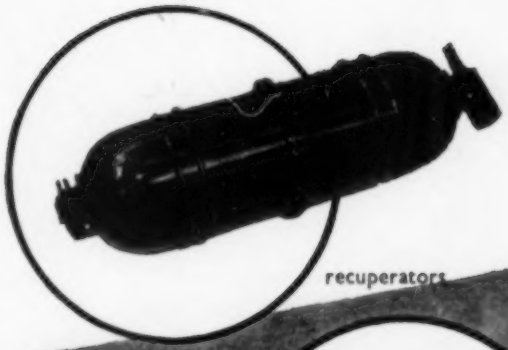
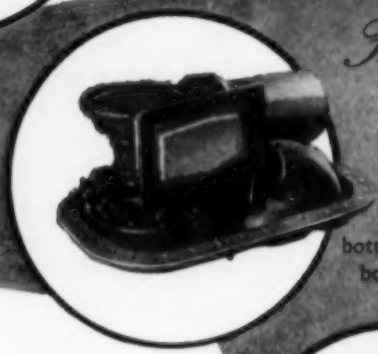
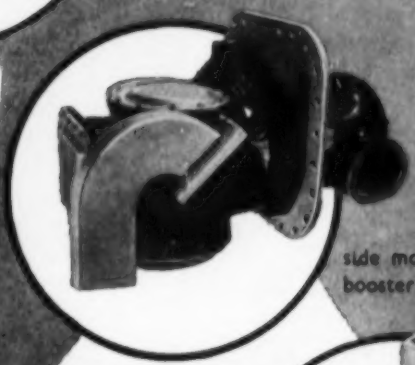


recuperators



bottom mounting booster pump



side mounting booster pump

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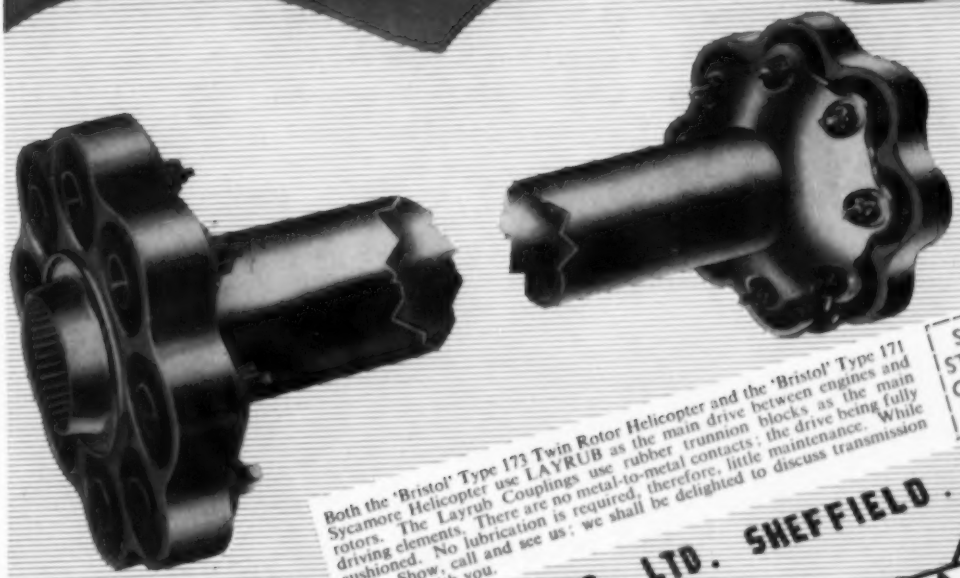

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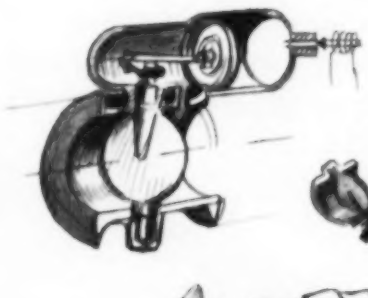

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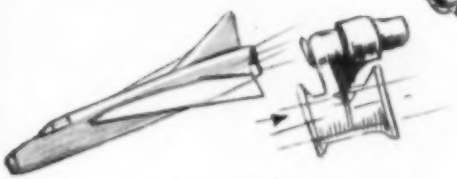

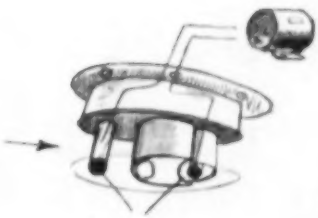

Elements

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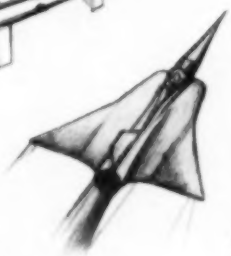

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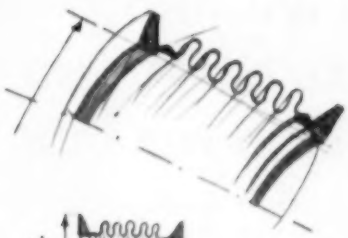

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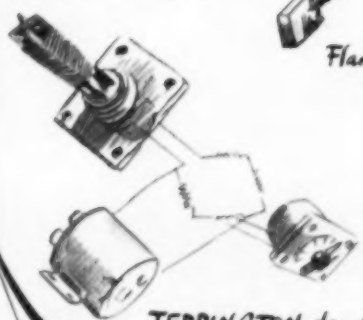

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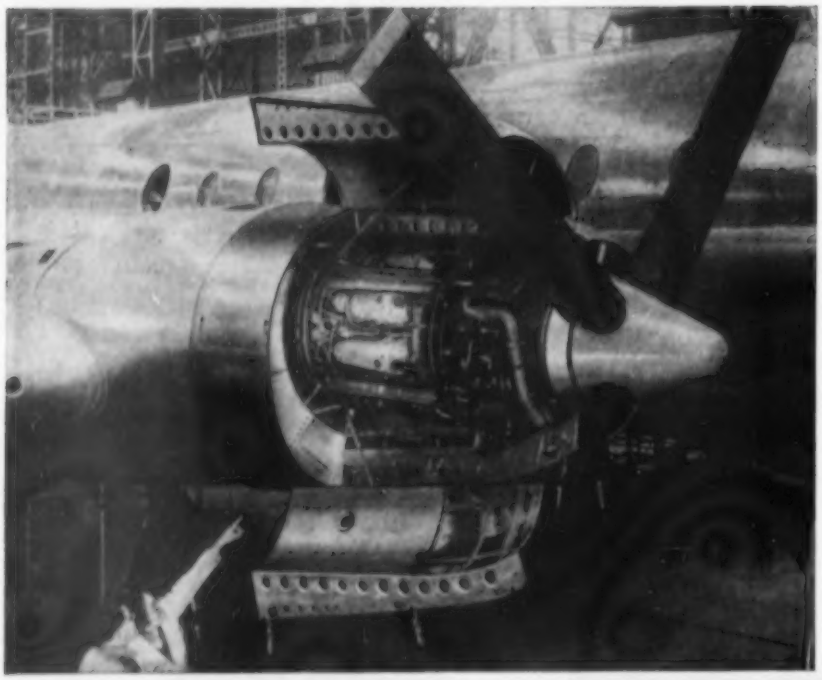

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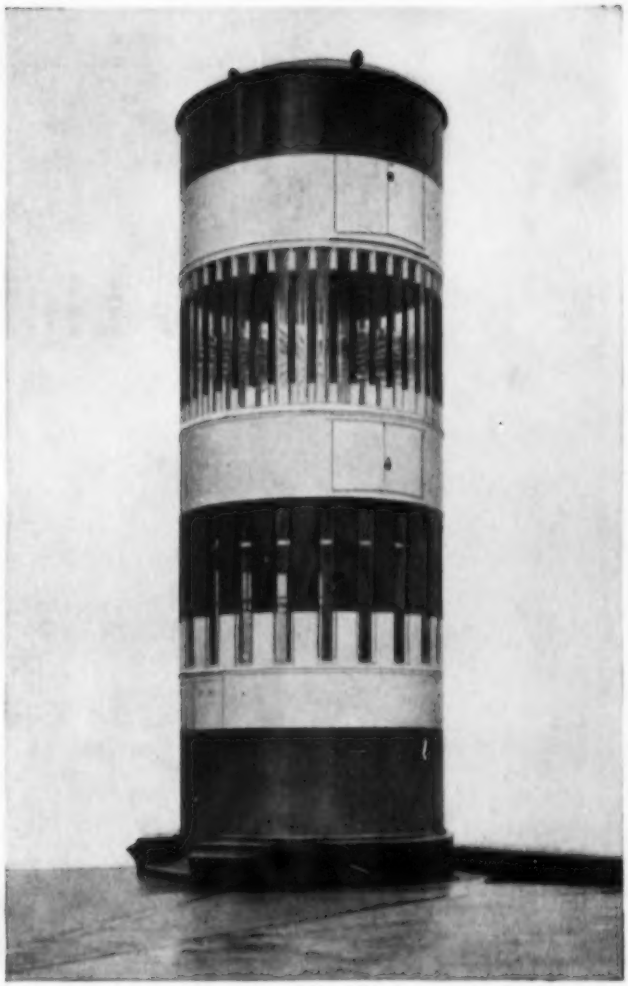

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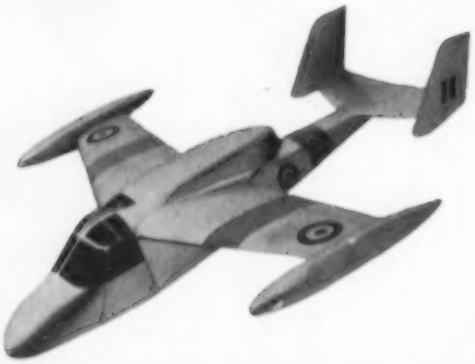

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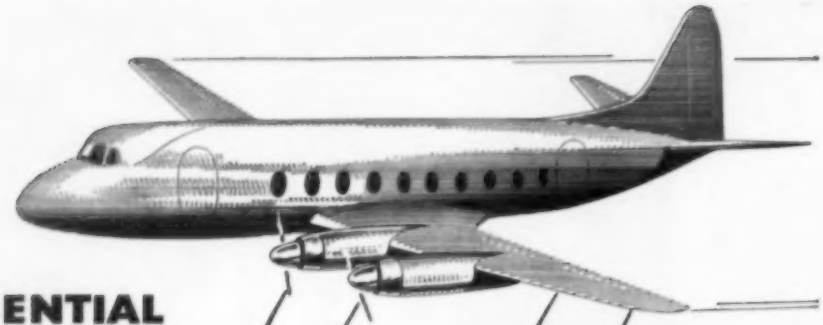

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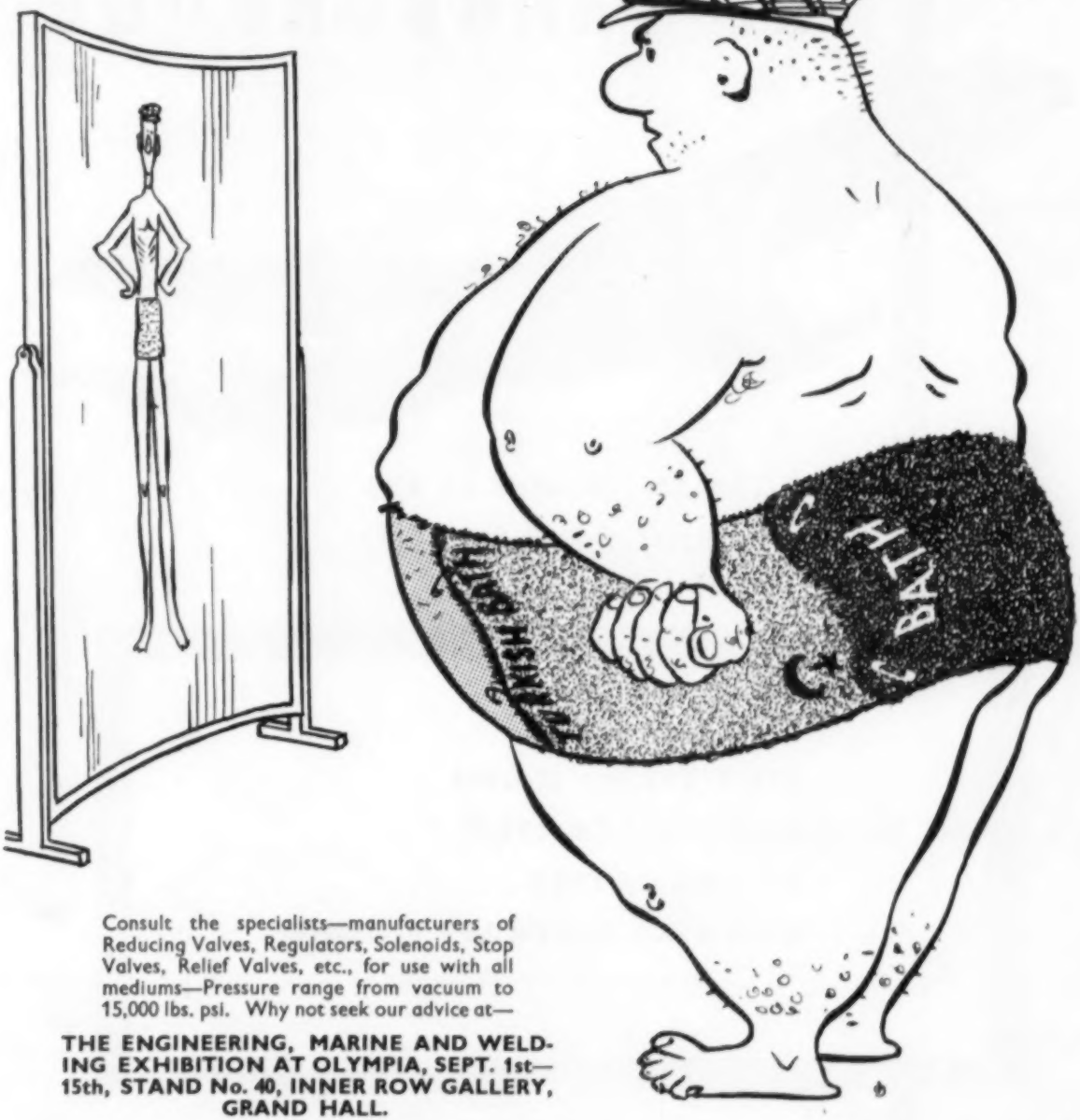

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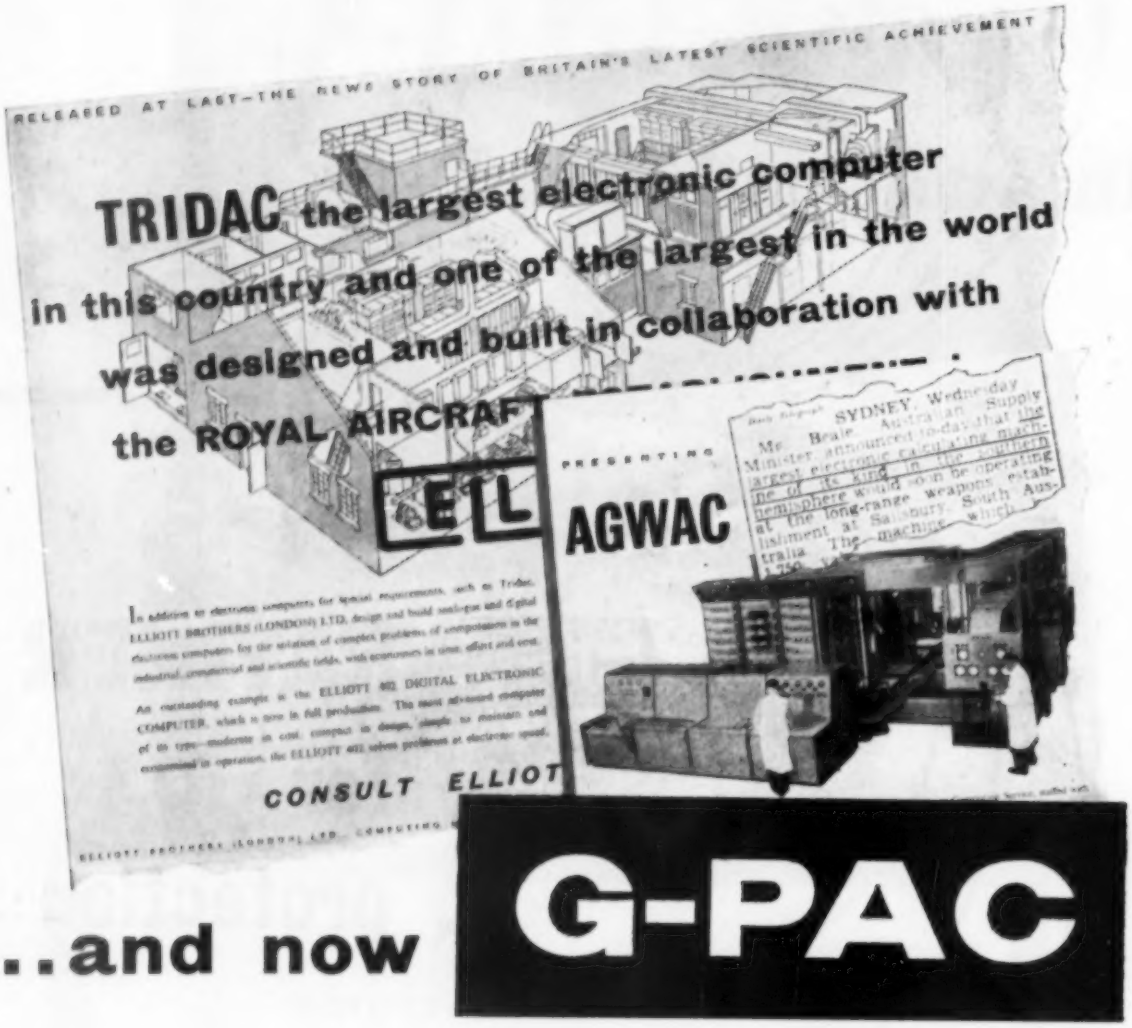
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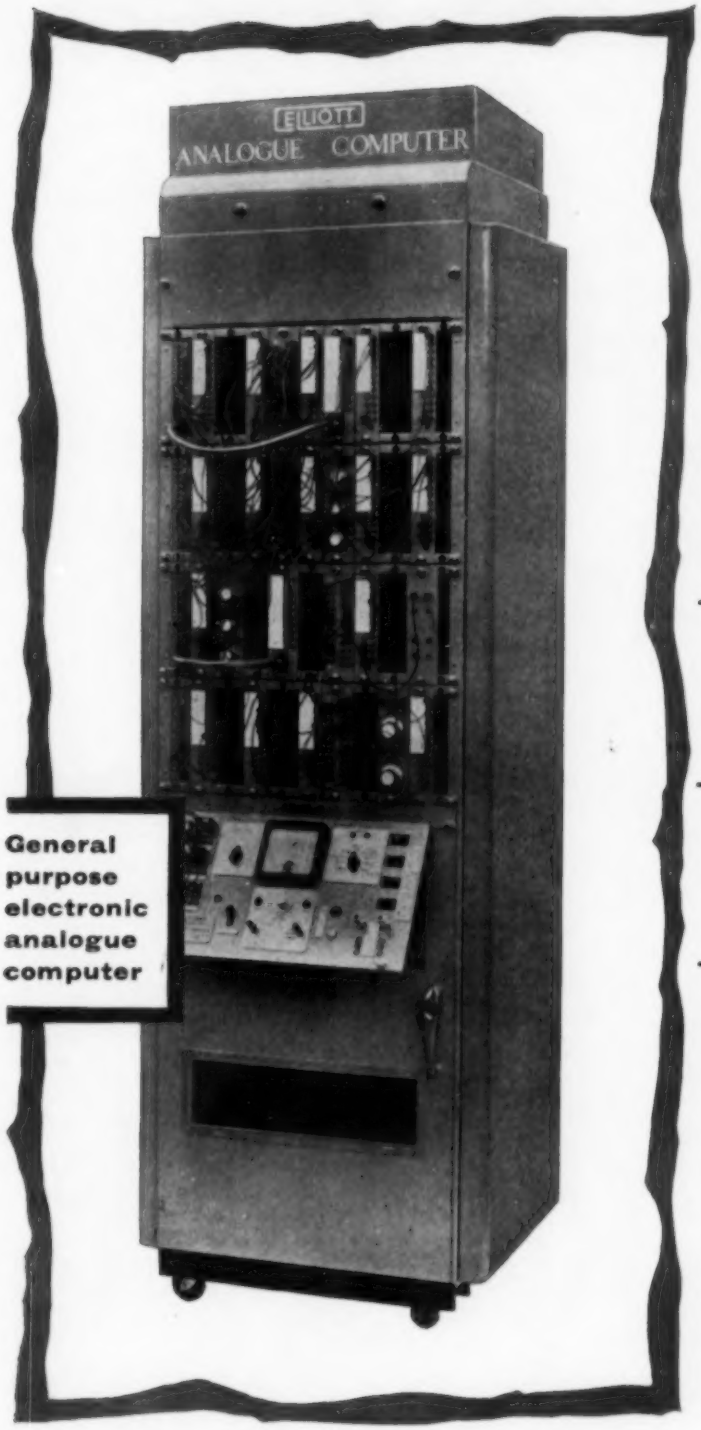

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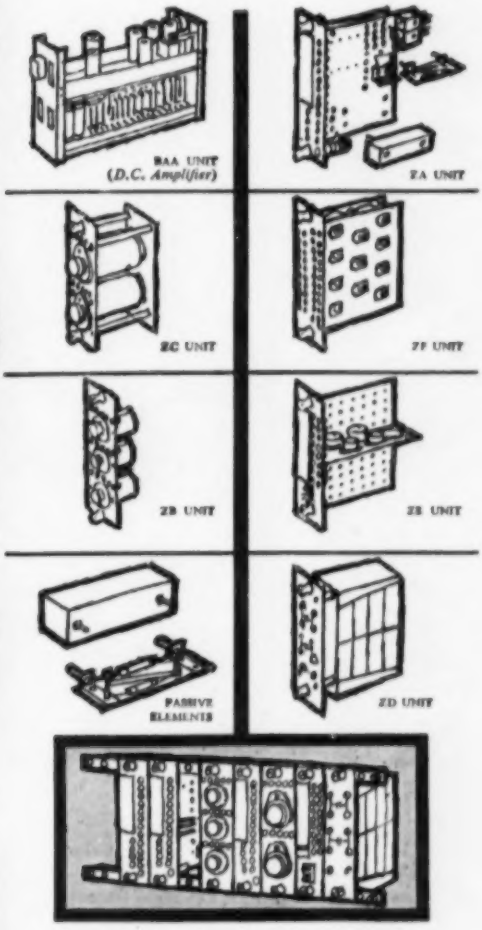

(Inset above). A problem board assembled externally to the computer, ready for patching.

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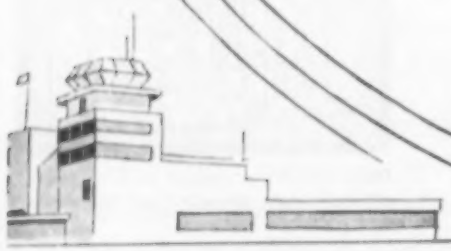

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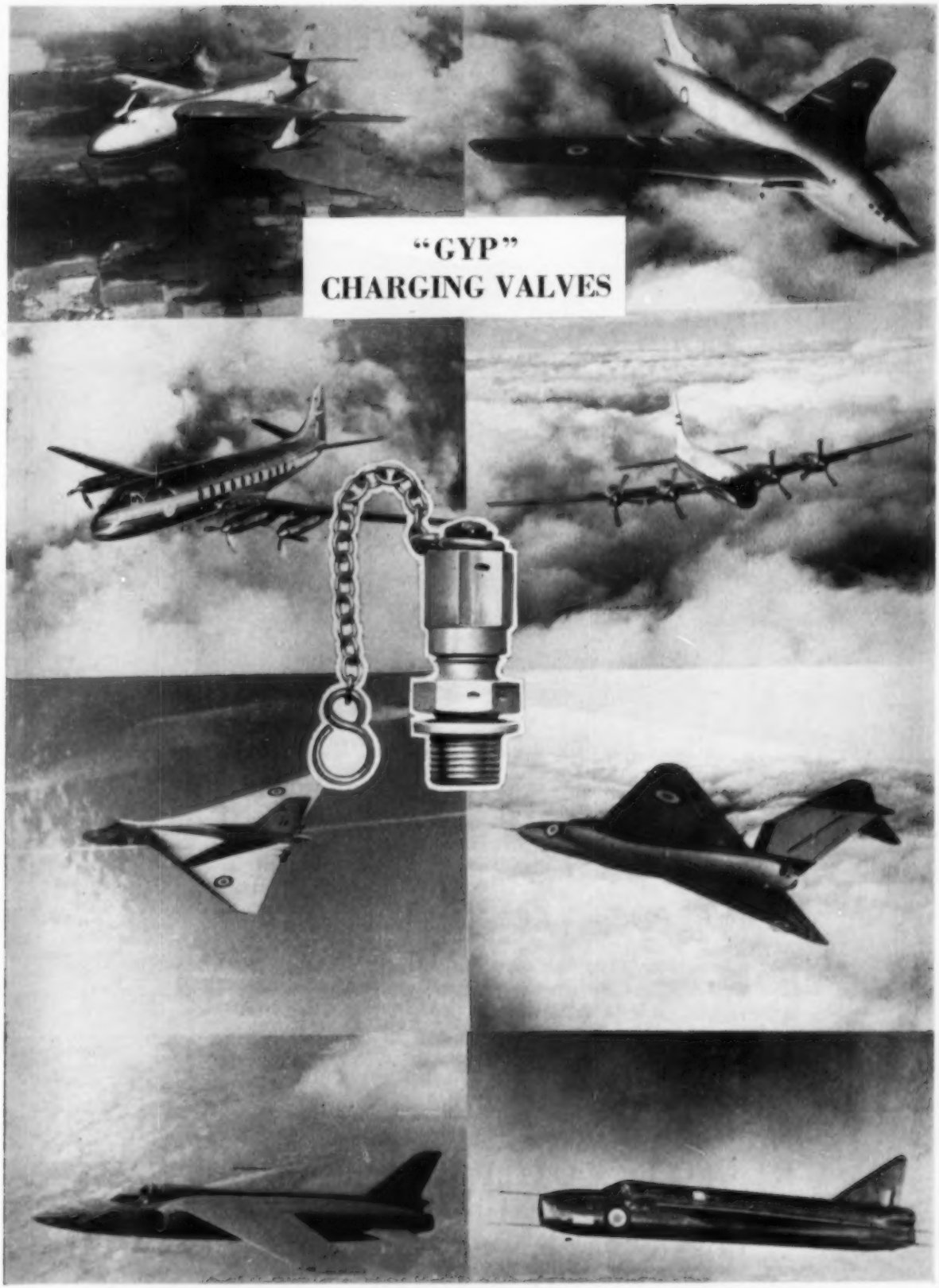

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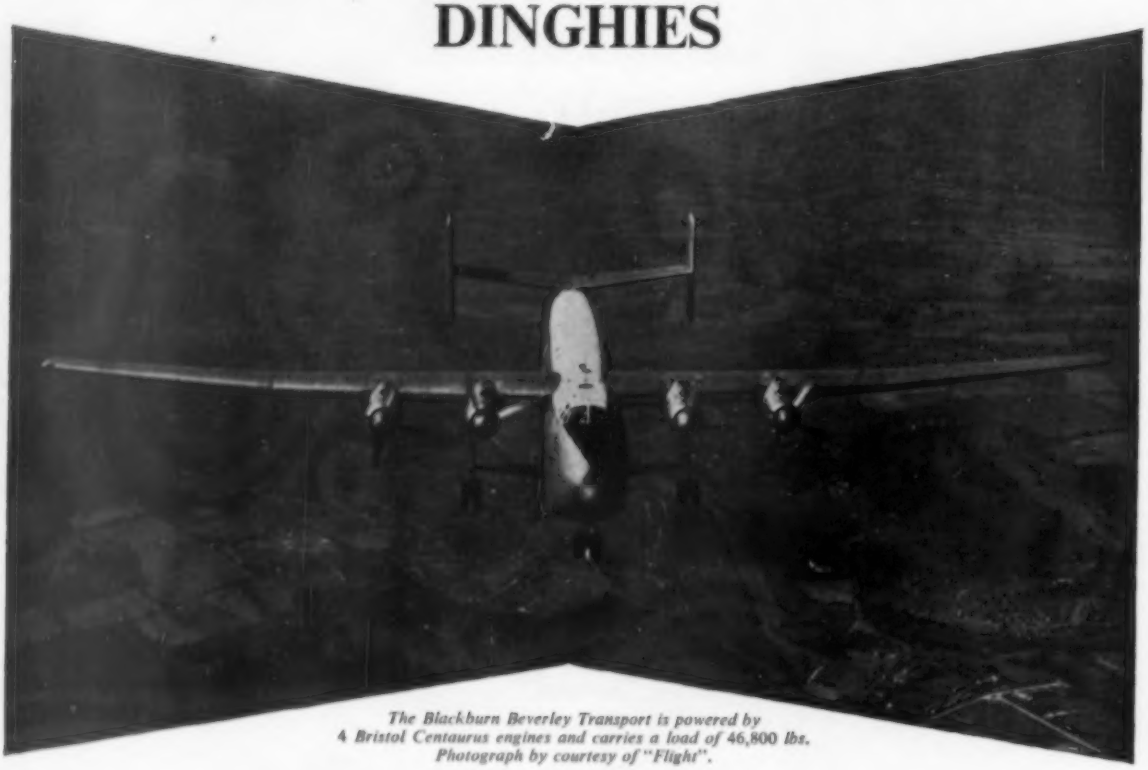

The Blackburn Beverley Transport is powered by 4 Bristol Centaurus engines and carries a load of 46,800 lbs. Photograph by courtesy of "Flight".

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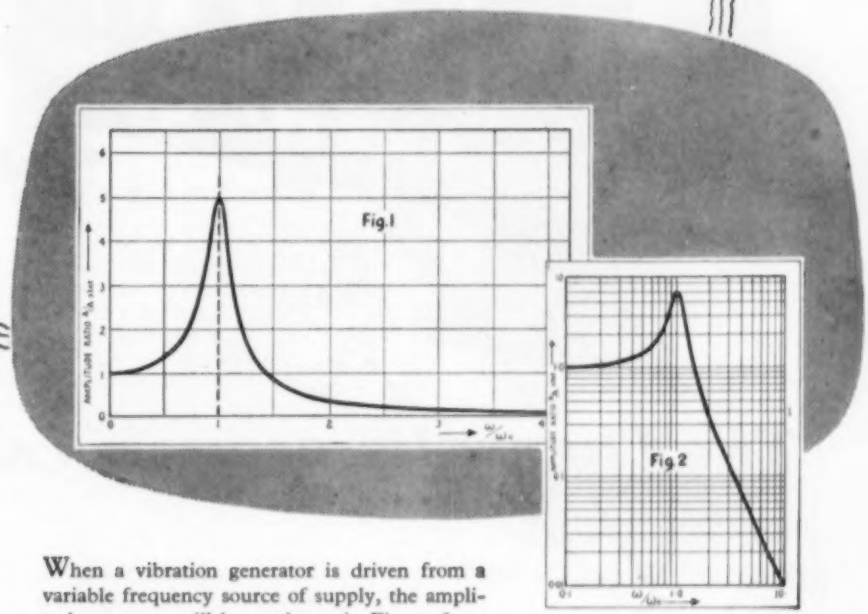

When a vibration generator is driven from a variable frequency source of supply, the amplitude response will be as shown in Fig. 1, for a given value of damping. The frequency at which the resonance peak occurs ω_0 is dependent on the total mass and stiffness of the dynamic system. At the lower frequencies, a substantially flat amplitude response is displayed and the system is stiffness controlled. At the higher frequencies the inertia force is predominant and the amplitude response decreases inversely as the square of the frequency. These points are shown more markedly in Fig. 2 where the same curve is plotted on logarithmic scales. The corresponding acceleration over the higher range being proportional to $A\omega^2$ is therefore constant. The constant amplitude response in the lower frequency range can be artificially extended by introducing extra stiffness in the form of springs so that ω_0 the frequency of the fundamental resonance is increased.

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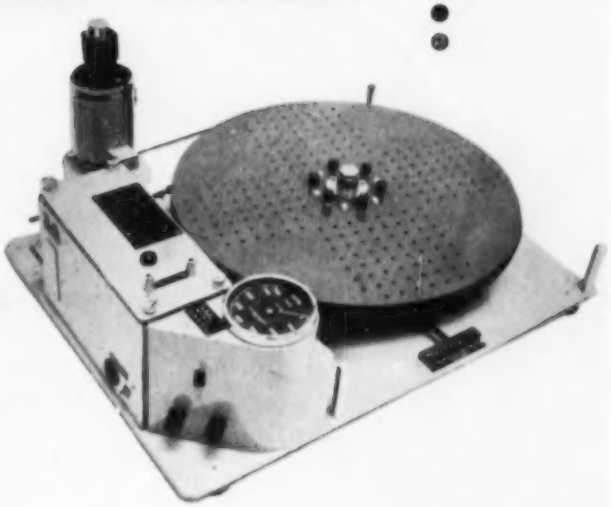

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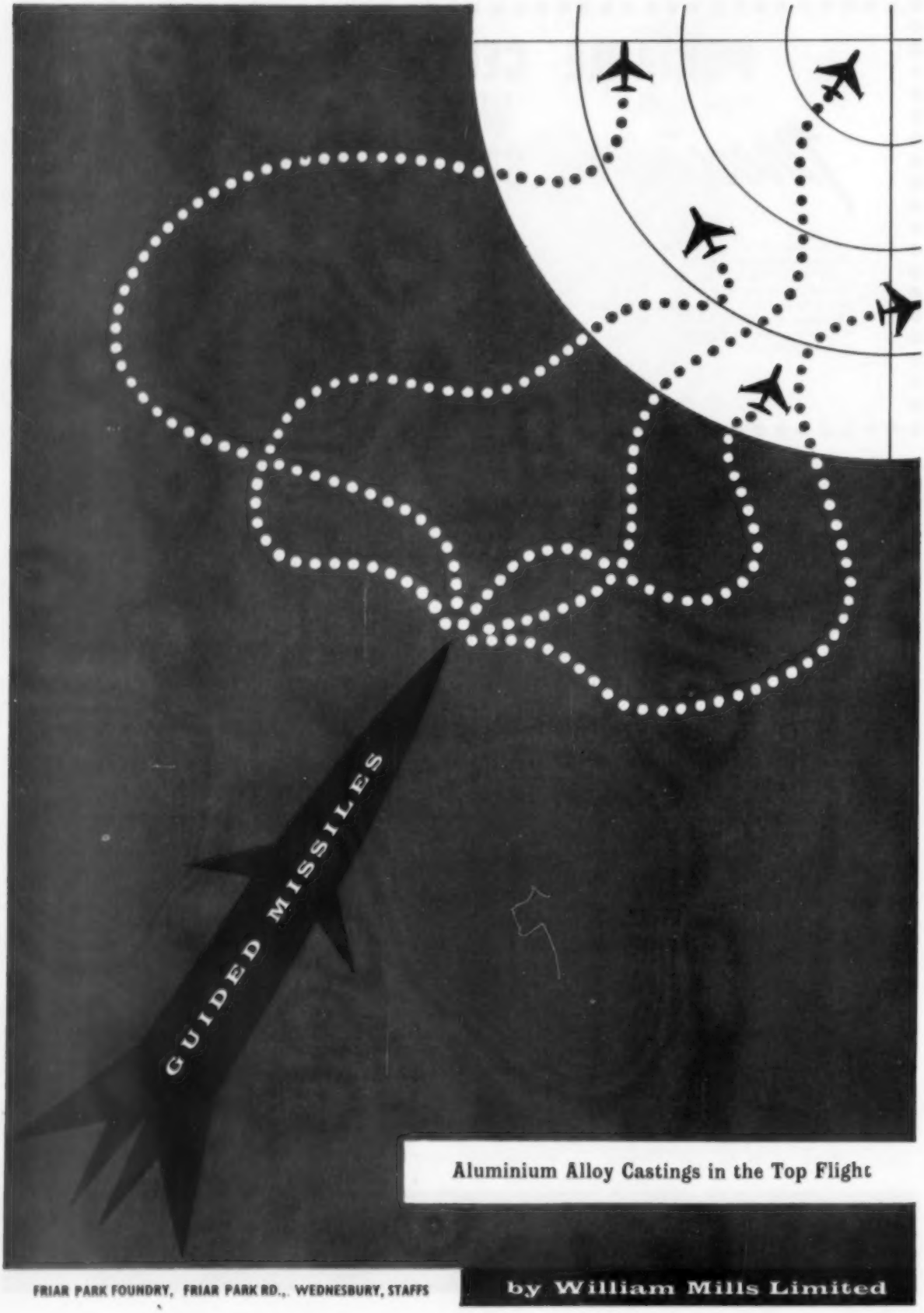

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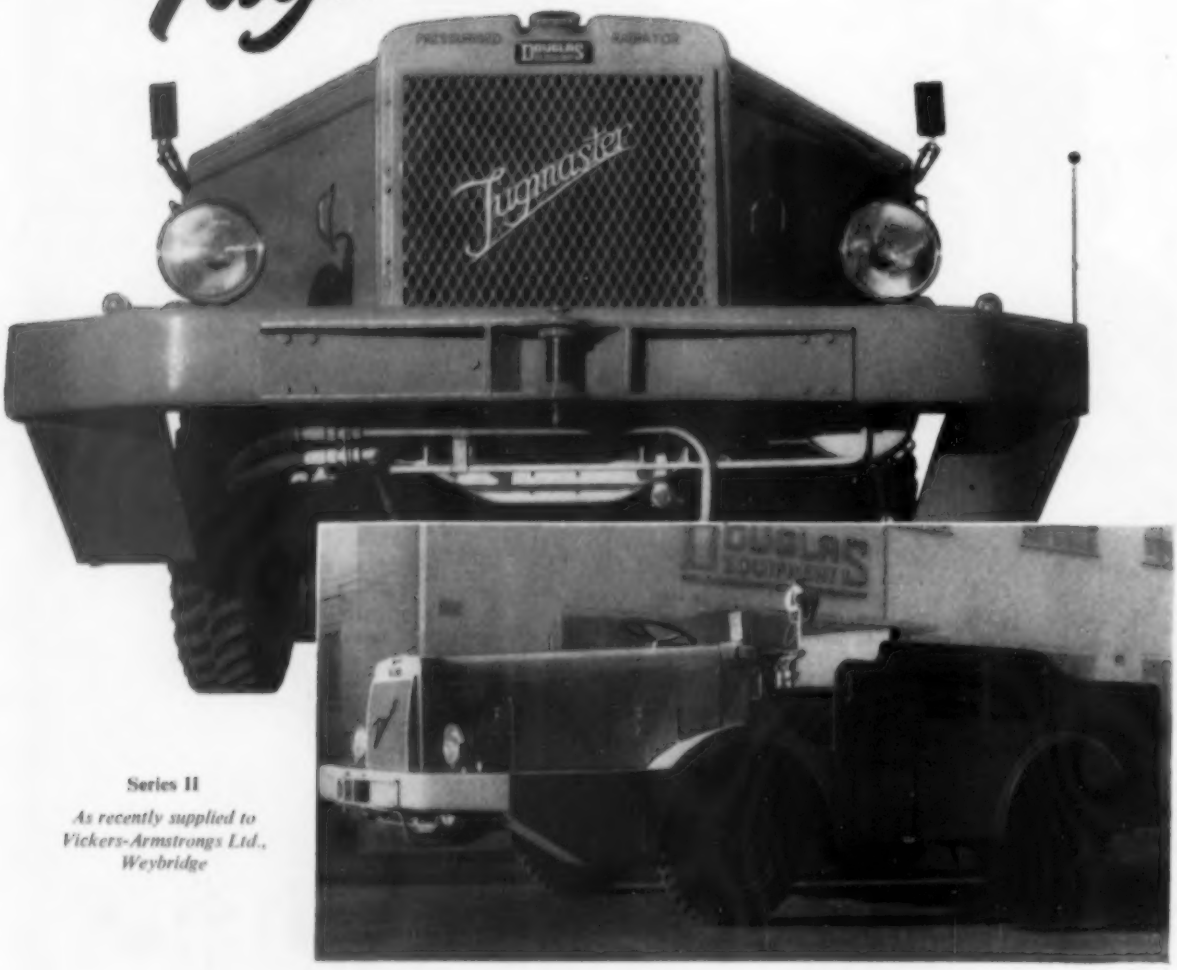

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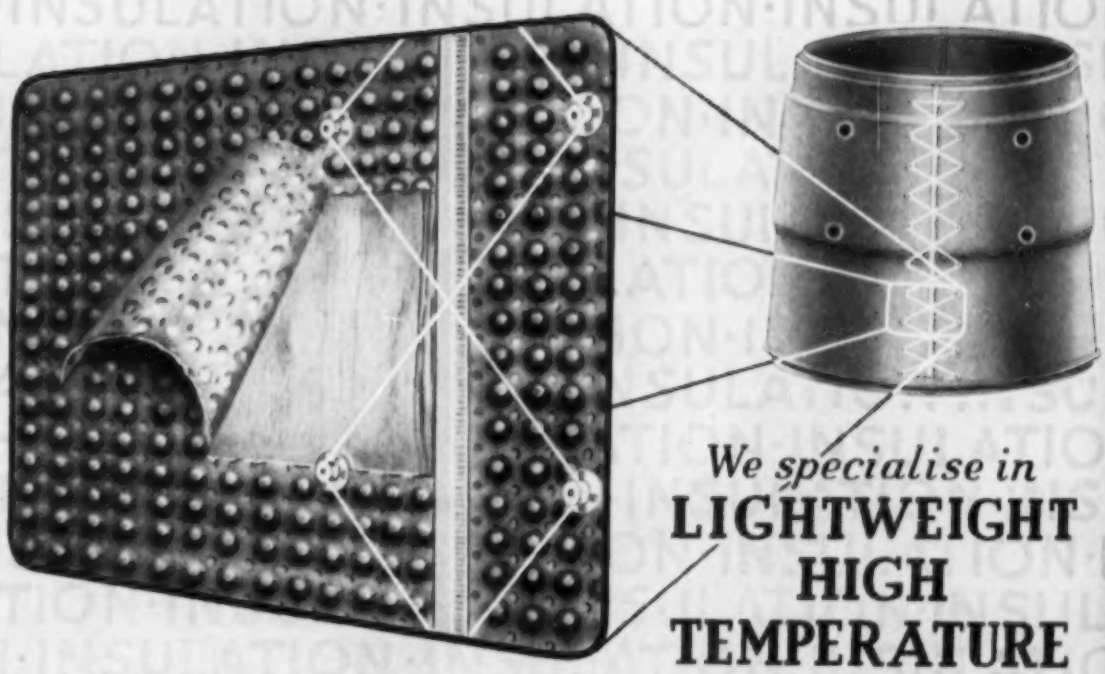

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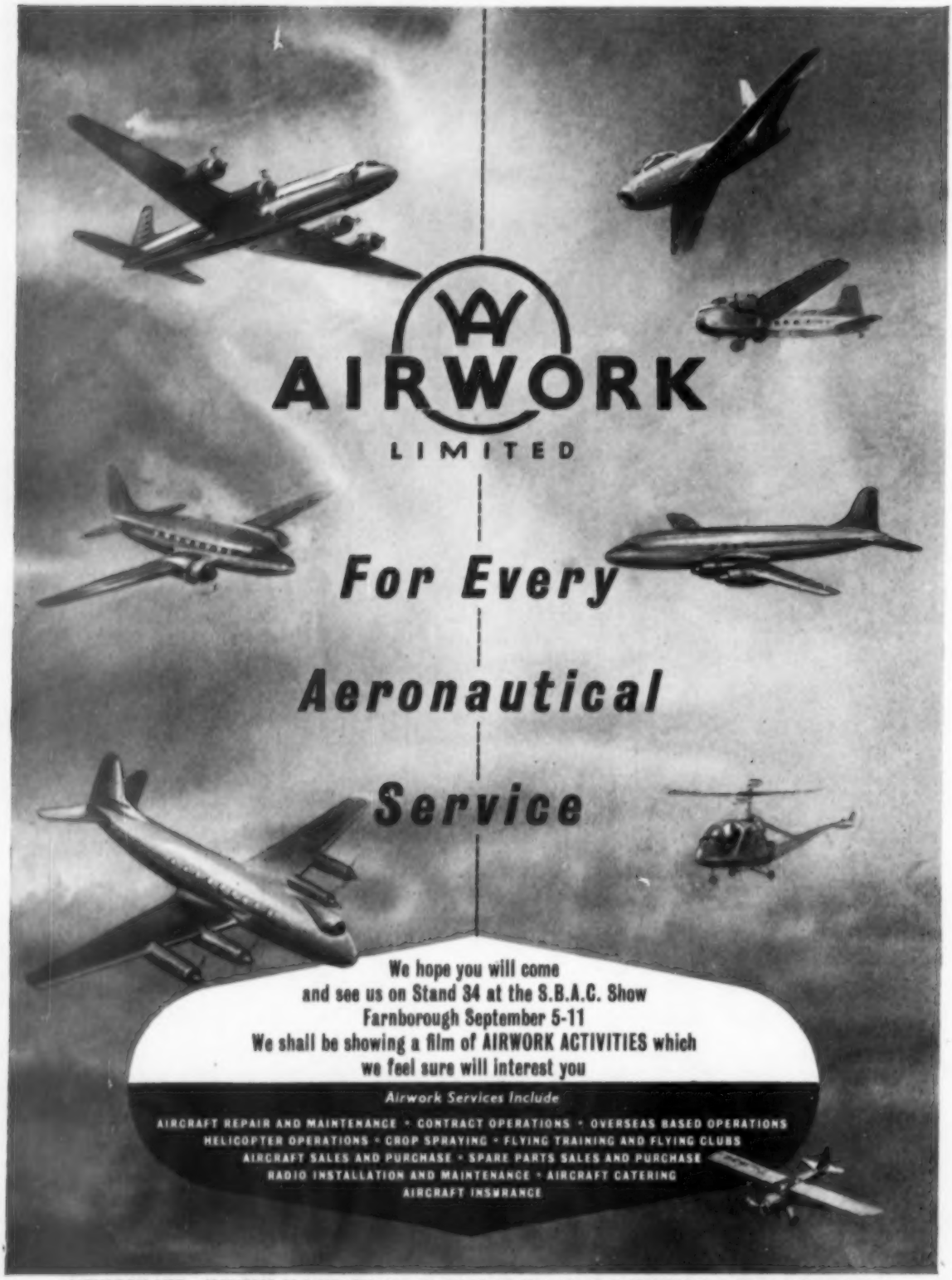
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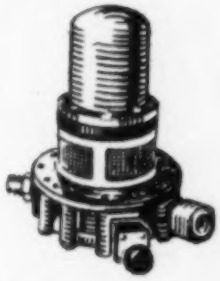

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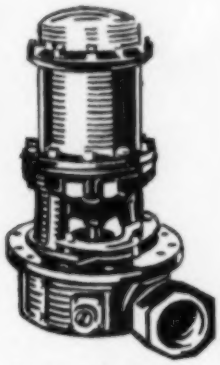

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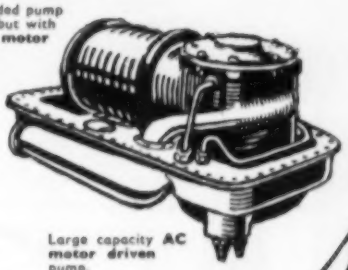

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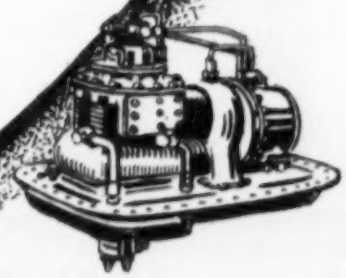

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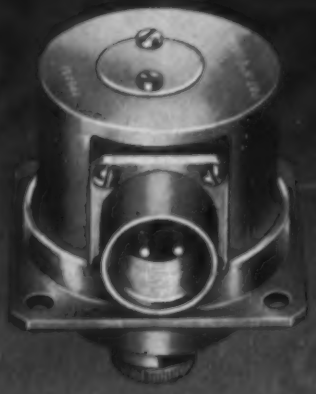

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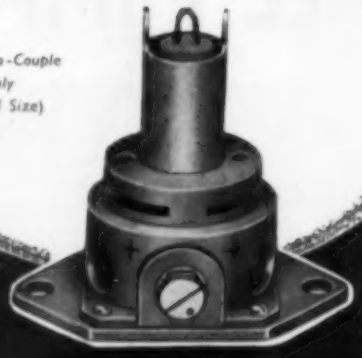

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Founded 1909

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IN THIS ISSUE:

News of the Week - 337-346
British Aircraft 1955 - 347
Sailplanes and Gliders - 385
Missiles and Targets - - 386
British Power Units 1955 387
Accessory Developments 399
Power Units Data - - 407
Military Aircraft Tabulated - - - - 403
Civil Aircraft and Helicopter Data - - 409
The Ministry's Contribution - - - 410
Farnborough Show Guide - - - - - - 410
The Ancillary Industry - 413

TO ALL our friends who, in early September, travel from almost every country in the world to visit England and, in particular, the Exhibition and Display of the Society of British Aircraft Constructors, we extend a warm welcome. We hope their stay here will result in pleasant personal contacts and, professionally, will prove a stimulating experience.

At Farnborough Next Week

IT is our custom in this annual special number, devoted to the British Aircraft industry, to review the latest products and practices of the manufacturers. We also examine broadly the progress made in aircraft design, the current requirements and the extent to which British achievement is leading, keeping pace or lagging by comparison with that of other nations.

When considering such matters, it is a pre-requisite to have one's timing clearly in mind, otherwise unfair comparisons will be almost unavoidable. In a slightly different context we commented last week on the gestation period of modern aircraft, estimating it at about seven years. Assuming that a prototype starts its flying life about half-way through this period, in the later stages there may be simultaneous flight testing of first, second or third-year prototypes in their various phases of development. The date at which they should be able to undertake the work for which they were designed is more significant than the maker's estimate of future performance. Again, it may be misleading to regard a transport as better or worse than another of equal capacity on the figures of the moment, when, in fact, the one is at the end of its development life, and the other at the beginning.

The basis for comparison is another matter which must be fairly considered. If one fighter, to meet a specification, must carry four 30-mm guns, then it must be expected to have fire-power advantages, but weight and performance disadvantages, when compared with another with lighter armament. It has been apparent for some time past that not only fighters but military aircraft in general are becoming less versatile. They can do as much as and more than their predecessors; but, to achieve the ultimate efficiency, they must be tailored to one task only. More than ever before, the armament to be carried is settling their size and shape.

Specialization is also the order of the day for the new gas turbines, as will be seen at Farnborough. This may in fact be remembered as an engine year, one marking the first showing of such outstanding new designs as the de Havilland Gyron turbojet for supersonic fighters, the Rolls-Royce Conway by-pass turbojet for transports, and the de Havilland Spectre and Armstrong Siddeley Screamer rocket motors. The Napier gas-producers, too, will be seen. The Bristol Orpheus may be lending its full thrust to the Gnat, the Armstrong Siddeley Viper to the Jet Provost, and the Alvis Leonides Major, for transports and helicopters, will be making its flying debut. And the list does not end here.

How do these products line up with their competitors abroad? So far as engines are concerned, there is none better anywhere. Of new transport aircraft in service, nearing service, or appearing for the first time, none holds more promise.

In the military field, the picture is, perhaps, a little less rosy, thought not discreditable to the designers and producers. The machines now going into service are the end-products of a difficult period, a period of rapid, unconsolidated progress, of financial stringency and of official procrastination. Here we are barely holding our own with America and with what is known of Russian equipment. A realization of the importance of exceptional high-altitude performance has had its effect on airframe and engine design. In this respect many of our aircraft are outstanding. Numbers are still very short, but potential customers will find the technical merit to be high, the cost reasonable and the quality of the engines such as to tilt the balance favourably.

FROM ALL QUARTERS

A FANFARE of Alvis Leonides Majors marked this, the first take-off, of the Handley Page Herald prototype. By Monday it had logged 10 hr 45 min, flying time. A closer picture of the handsome H.P. newcomer is on page 346.

The Herald Flies

THE maiden flight of the Handley Page Herald (four Alvis Leonides Major engines) was made from Radlett on the afternoon of August 25th. The Herald was airborne for 30 minutes, and the pilot, S/L. H. G. Hazelden, was accompanied by Mr. R. J. Davies, chief aerodynamicist of Handley Page (Reading), Ltd. "Hazel" is said to have remarked, "I never knew our runways were so long; take-off and landing were very short." He added that he was highly satisfied.

New World Speed Record?

A NORTH AMERICAN F-100 Super Sabre is claimed to have set up a new world speed record of between 800 and 900 m.p.h. over a 15-25 km course at Palmdale, California. The pilot was Colonel Horace Hanes, flight test director at Edwards Air Force Base, California. The recordings are still being studied and the exact figure will not be announced until the National Aircraft Show at Philadelphia, during the week-end September 3rd-5th. By that time, of course, the speed may have been further improved.

The new record is the first to have been set up at altitude under the new F.A.I. conditions, and was timed with "new optical instruments."

—a Height Record Too?

AT 3 p.m. last Monday, Bristol assistant chief test pilot Walter Gibb took off from Filton in the Olympus-Canberra in which, during May 1953, he established a world's height record of 63,668ft. The Canberra, which has since been fitted with two Olympus 102 BOl.11 turbojets, was airborne for one hour. Gibb's purpose was to better his own record and, accordingly, G/C. du Boulay and Mr. Philip Mayne, of the Royal Aero Club, were in attendance. Personnel of the R.A.E. were engaged in calibration, but as we go to press it was considered unlikely that the outcome would be known before the end of the week.

Bristol/Solar Agreement

IT was announced on Monday that the Bristol Aeroplane Co., Ltd., have acquired exclusive Commonwealth rights to the manufacture and sale of the afterburner equipment designed and developed by the Solar Aircraft Co., of San Diego, Calif. The agreement—which is subject to British Government approval—provides for an eight-year period of technical collaboration during which Solar will assist in the design and production of reheat systems for Bristol engines.

Mr. Lear Follows his Star

FOUNDER and chairman of the American firm of Lear, Inc., Mr. William P. Lear is shortly to make "an extended visit" to Europe. Well known as manufacturers of aeronautical equipment, his company a year ago began production of the 14-seat twin-engined executive Learstar—a converted Lockheed Lodestar.

"I am about to complete the arrangements for the production of a brand new Learstar in one of two European countries," he is quoted as saying. "It will have a range of over 3,000 miles and a cruising speed of 500 m.p.h." He added, according to the same report, "We have figured out that the plane we want to build would take eight years to produce in the United States while in Europe we'll have it off assembly lines in less than three. The same applies to a great number of new types of various equipment built by engineers in Switzerland, Germany, Italy, France and England. Much of it can be put to much greater use in our era of rockets and embryonic space ships than the inventors themselves realize."

Within the next few weeks Mr. Lear, followed by his wife and four children, is to take up residence in Geneva.

FAIREY DELTA TWO: The Fairey F.D.2 supersonic research delta, powered with a reheat Rolls-Royce Avon turbojet, is flying again after repairs and modifications following a belly landing. This is certainly one of the world's fastest aircraft, and is a potential vehicle with which to surpass the new, unofficial, speed record by the North American F-100 (see news item above).

FAIREY ULTRA-LIGHT: The first flight of Fairey's ultra-light helicopter, primarily intended for air observation post and "run-about" duties with the Army, was made by S/L. W. R. Gellatly, A.F.C., at White Waltham on August 14th. As seen here, it is a trim little effort, and it promises well. The Blackburn Palouste supplies compressed air to Fairey pressure jets at the rotor tips. The tail is probably a prototype assembly only.

Project Y Again

OFFICIALS of the Canadian Government stated in Ottawa on August 23rd that negotiations were going on between the United States Government and Avro Aircraft, Ltd., whereby the U.S.A.F. would assume the costs for renewing research on "the so-called flying saucer type of military aircraft." In this connection it will be recalled that Canada's Defence Minister, Mr. C. D. Howe, stated in London earlier this year that the project (commonly known as "Y") had been shelved. Under the new United States contract, completed several months ago, it will become the exclusive property of the United States Air Force.

Mr. S. D. Davies' New Post

Mr. Davies.

IT is announced that Mr. S. D. Davies, B.Sc., F.R.Ae.S., who until recently was chief designer to A. V. Roe and Co., Ltd., has joined the Dowty Group. He has been appointed to the boards of Dowty Hydraulic Units, Ltd., Dowty Mining Equipment, Ltd., and Dowty Nucleonics, Ltd. It is stated that he will be mainly concerned with industrial activities and particularly with the application of automation in the industries served by the group. His long experience in the aircraft industry will, however, be available to Dowty Equipment, Ltd., for whom he will act in a consultative capacity.

Australia's Production Future

WELL known as a director of Commonwealth Aircraft Corporation, Sir Lawrence Wackett said on August 23rd that Australia had one more year in which to make up her mind whether to build new supersonic fighters or to waste the money and effort she had expended in getting up to date. Addressing the Australia-New Zealand Science Congress, Sir Lawrence gave warning that the possibility must be faced of losing both aircraft and test pilots in carrying through a modern production programme.

It was unlikely, he said, that Australia would ever again attempt to produce a complete aircraft of her own, except for a trainer; instead, she would modify and improve some existing design.

Sir Lawrence alleged that representatives of aircraft-importing firms were negotiating continuously to retard the Australian effort to build an industry which alone could give Australians some self-sufficiency in defence.

On August 13th Air Marshal Sir George Jones had told an Air Force Association conference that Australia would be building aeroplanes capable of 1,000 m.p.h. within three years. Sir George, who is also a director of C.A.C., said later he understood these supersonic aircraft "would be of American origin"; but he would give no further details.

Westland's New Helicopters

THE first Westland Widgeon helicopter, briefly described on page 383, made its first flight—of half an hour—at Yeovil on August 23rd. The pilot was Roy Bradley. A preliminary specification of this Dragonfly development (the designations S-51 and S-55 have now been abandoned) quotes an empty weight of 4,424 lb, a gross weight of 5,900 lb, and a maximum payload of 1,108 lb for a range of 20 nautical miles. Maximum range with no allowances is 262 n.m. True maximum speed at sea level is 83 kt, normal cruising speed 70 kt, and rate of climb at take-off engine power at sea level 970ft/min. Service ceiling is 10,500ft, and hovering ceiling, with 10ft wheel clearance, 7,500ft.

The new—Mark 5—version of the Widgeon, with Alvis Leonides Major engine (scheduled to be demonstrated, together with the Widgeon, at Farnborough) has an empty weight of 5,262 lb and a maximum all-up weight (civil) of 8,000 lb. True maximum speed at sea level is 95 kt, and maximum rate of climb at sea level 825ft/min. Service ceiling is quoted as 12,500ft, hovering ceiling (10ft wheel clearance) as 7,000ft, and range, with no allowances, and standard tankage, as 300 n.m. Fuel consumption is 39 gal/hr, and maximum range (no allowances), 1,214 miles.

P.1 "Uncovered"

ONE of the two English Electric P.1 prototypes was brought safely back to Warton Airfield last Friday by W/C. Roland Beamont after the cockpit cover had blown away following the failure of the release mechanism.

Pending an investigation of the incident, W/C. Beamont declined to go into details, merely saying that "it was very windy, and for a short time things were difficult." He was unhurt.

The P.1 had been in the air for three minutes when the canopy disappeared and Beamont landed it five minutes later. The cover fell into a street at Morecambe, narrowly missing (it was reported) an old lady and cracking a paving stone.

WIDGEON is the name adopted for this new, and greatly improved, development of the Westland Dragonfly helicopter. Together with the new Alvis Leonides Major-powered version of the Whirlwind, it should make an initial appearance at Farnborough next week.

AIRBORNE AGAIN after its recent belly-landing, following a hood failure, is the Folland Gnat, seen in this "Flight" photograph, secured last Thursday from a Valetta over the South Coast. With a Bristol Orpheus delivering most of its designed thrust the Gnat is tipped for a flashing performance at Farnborough. Gross weight, in demonstration trim, should not exceed 6,000 lb.

FROM ALL QUARTERS . . .

Sweden's First Hunter

SHADES of the Swedish Harts and Ospreys of pre-war years must have been aroused when the first Hunter F.4 for the Royal Swedish Air Force was flown from Dunsfold to Stockholm on August 26th. The machine was the first of a batch representing a £12,300,000 order and was flown by Major R. Stenberg. One refuelling stop was made, at Jever, in Northern Germany.

The Swedish designation will be J 34, and two wings will be equipped with the type—F 18 at Tullinge, and F 8 at Barkaby. Hitherto, F 18 has been equipped with J 28B Vampires and F 8 with J 29s. When the Hunters are delivered, the J 29s will be transferred to F 15, replacing the last J 28Bs still in service.

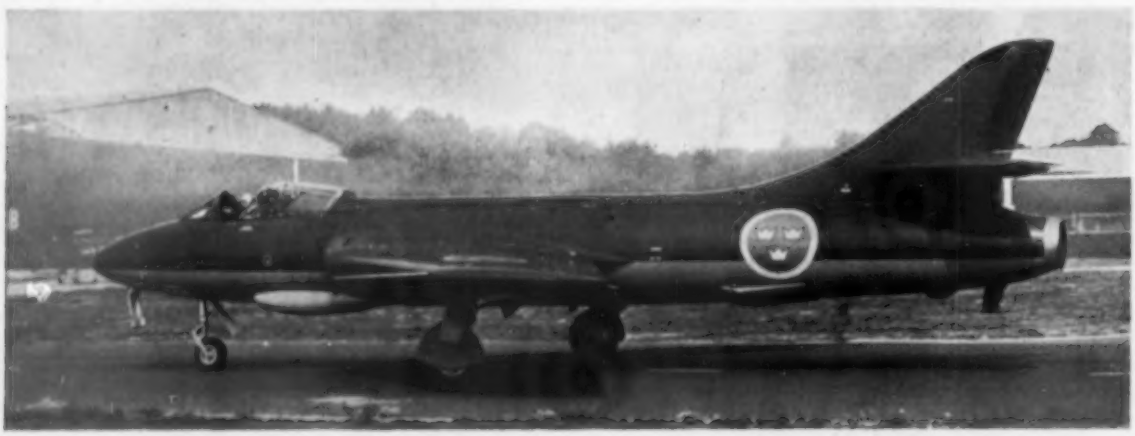
Total export orders for the Hunter amount to £121,000,000. Machines of this type have been ordered by Denmark, and Holland and Belgium are building under licence.

The Hoover Report

THE report of the Hoover Commission, dealing with off-shore procurement and released by the U.S. Government on August 24th, might fairly have been described as a distasteful admixture of half-truths and out-of-date facts. Of the Canberra it was said that it "is a good light bomber which is reportedly nearing obsolescence, and is not regarded highly as a weapon according to United States standards." The Swift was reported to be in very serious difficulties, due to lack of stability, and there was even a strong possibility that it might be "cancelled out" by the Ministry of Supply. The Hunter, too, came under fire ("production held back because of deficiencies . . . the few squadron Hunters are flying under strict limitations . . ."), and the Javelin was described as "obsolescent, with only brief front-line usefulness because of late delivery."

On the day following release it was learnt that both the U.S. Defense and Mutual Security Departments were rejecting the report. A Defense Department spokesman described the Hunter

THE THREE CROWNS of Sweden lend a new dignity to this Hawker Hunter F.4, first of a batch for the Royal Swedish Air Force (see news item on this page). On the right is the pilot—Major R. Stenberg—who collected the aircraft from Dunsfold.



ROUND TRIPPERS: Capt. J. W. Hackett (right) and Nav/Off. P. J. Moneypenny emerge (a little wonderingly?) from the Canberra P.R.7 on their arrival at Floyd Bennett Field, New York. In the larger picture Capt. Hackett faces the newsreel cameras while the aircraft is refuelled during the 35-min turn-round. He later described the American co-operation as "simply terrific."

as a "modern combat weapon" which would substantially strengthen Western defence, adding that Great Britain was expected to turn out 515 Hunters financed with U.S. foreign aid funds before June 30th next. No thought was being given to cancelling this contract, despite the Hoover group's criticism suggesting such a step. Defense Department officials declared that they were confident that the Hunter, when modified, would be "the best intercepter day fighter in Western Europe."

The spokesman of the Defense Department said that the policy of ordering aircraft from British factories was part of a move "to establish a healthy aircraft industry in Europe which will be capable of providing plans and logical follow-up support necessary for adequate air defence in Western Europe." By helping Western European countries to manufacture their own aircraft, it was possible to hasten the time when Europeans could support themselves and not be dependent on the United States to bear "the staggering cost of maintaining NATO air forces."

The spokesman confirmed, in effect, the Hoover Commission's disclosure that about $100 million (nearly £40 million sterling) previously earmarked to buy Javelins had now been allocated to other purposes. This move was necessary, he said, because of "production delays in Britain in turning out combat-worthy models." It was possible, however, that once the Javelin was "successfully flight-tested some time in the autumn" additional funds might be allocated for this purpose. An earlier contract calling for 117 Javelins at a cost of $65,000,000 (£23,214,000) would not be affected by this move.

A National Security report to Congress released in Washington on August 25th said that by the middle of this year more than 375 aircraft made in Great Britain—Canberras, Valiants and Hunters—were delivered to the R.A.F. through National Security funds.

In an interview, Mr. Bernard S. Van Rensselaer, primarily responsible for the Hoover Commission's criticisms, is reported to have said that Britain had been ahead on engines, but America had been ahead on airframes. He added that the Hunter, Javelin and Swift troubles might have been avoided and development accelerated if there had been greater exchange of skills between the two nations.

The Shrinking Atlantic

THE English Electric Co., Ltd., must have been gratified at the degree of public interest occasioned by the one-day, two-way Atlantic crossing of their Canberra P.R.7 on August 23rd. The crew—Capt. John Hackett and Nav/Off. Peter Moneypenny—certainly executed what the Prime Minister described, in a message of congratulation, as "a brilliant flight."

America, too, was generous in her recognition. The New York *Daily Mirror*, for instance, described the flight as a "stirring accomplishment," adding, "The British have been ahead of us for years in jet development and thus deserve to be able to claim the first round-trip Atlantic record."

As reported in these columns last week, the aircraft left London Airport at 0710 hr B.S.T. It first flew over Croydon Airport for official timing (0718 hr) by the Royal Aero Club observers and then headed westward, reaching Floyd Bennett U.S.N. airfield, New York, in 7 hr 29 min 56.7 sec, representing an average speed of 461.12 m.p.h. for the observed distance of 3,457.96 miles.

After a 35-minute turn-round the Canberra took off at 1523 B.S.T. and, aided this time by a favourable wind, crossed the Croydon check point after 6 hr 16 min 59.5 sec, a speed of 550.35 m.p.h.

Subject to F.A.I. confirmation, both flights are records, as is the round-trip time of 14 hr 21 min 45.4 sec (481.52 m.p.h.); this includes the turn-round time.

At Floyd Bennett Field, after a landing in rain and poor visibility, the aircraft was refuelled by a mixed party of U.S.N. and industry personnel, under the direction of Mr. Douglas Potter of English Electric. Mr. Joe Duncan of Rolls-Royce, Montreal, supervised a check-over of the Avons, assisted by an electrics specialist, Mr. W. Johnston. Mr. Charles Shelton, of Marconi, inspected the radio equipment. Shell A.T.F. was used for the flight. Incidentally, a reported fuel leakage—apparently from the belly tank—when the Canberra returned to L.A.P. was subsequently explained by the crew as slow draining of excess fuel following the quick refilling at Floyd Bennett Field.

Describing their flying technique for *Flight* after their return, Hackett and Moneypenny first paid a tribute to the help and accuracy of London Radar and of the R.Ae.C. observers at Croydon, at both the start and finish of the flight. The same additional fuel tankage was fitted as for the R.A.F. Canberras in the New Zealand race; tip tanks were jettisoned on the westward flight at 12½ deg W, and were not required on the return leg.

The Canberra's initial climb was made at 360 kt up to 20,000ft, and continued at M=0.75 to 39,000ft; from this height a cruising speed of M=0.76 was gradually increased to M=0.81, with a corresponding gradual climb to 48,000ft. The only fault experienced was a failure of the starboard navigation light, following the explosive release of the tip-tanks. Equipment carried included a radio compass (which was used continuously) but no autopilot.

The flight was not, as widely thought, the first two-way Atlantic crossing in one day, though that honour also fell to a Canberra (Belfast - Newfoundland - Belfast, August 26th, 1952).

The new time from New York to London makes a startling contrast with the existing official record, which has stood since 1937 at 20 hr 29 min (Merrill and Lambe, Lockheed Electra). The east-west flight had never been officially timed until the P.R.7 made the journey.

Capt. Hackett and Nav/Off. Moneypenny—who were engaged by English Electric for the attempt because the firm's own pilots were so fully engaged with test work—are both members of Silver City Airways, and normally fly on that company's Channel services. They have, however, ferried a number of Canberras to South America, establishing unofficial records.

***SIXTY-DEGREE SWEEP** on the leading edge of the delta wing of the Fairey F.D.2, combined with an extremely thin wing-section and the power of a reheat Rolls-Royce Avon, renders this machine highly supersonic. Other features can be studied in this—one of the first flying pictures—in conjunction with another appearing on page 338.*

FROM ALL QUARTERS . . .

Lecture Season Opens

IT is the custom of the Helicopter Association to hold a lecture meeting immediately preceding its annual dinner, and this year's speaker is to be Mr. R. Allen Price, of the Parsons Corporation, Traverse City, Michigan, who is to address the Association on *The Design, Development, Production and Servicing of Helicopter Rotor Blades*. The paper will be presented in the Ballroom Lounge of the Dorchester Hotel, Park Lane, London, at 5.30 p.m. next Thursday, September 8th.

Another lecture being given during Farnborough week—and actually at Farnborough, in the main assembly hall of the R.A.E. —is on Monday, September 5th. Members of the Society of Licensed Aircraft Engineers will be hearing a joint paper on *The Engineering Aspects of Test Flying*, by Mr. C. F. Bethwaite, B.Sc., and W/C. P. Brown, O.B.E., A.R.Ae.S. Mr. Bethwaite is superintendent of the flight test department of A. V. Roe and Co., Ltd., and W/C. Brown manager of the experimental department. The lecture will be at 7 p.m.

The first of a series of memorial lectures commemorating the name of the late Dr. Albert Plesman of K.L.M., sponsored by the International Air Transport Association and the Technological University of Delft, has now been announced to take place on September 12th. It will be given at Delft by Mr. J. D. Pearson, managing director of the Rolls-Royce aero engine division, and his subject will be *The Development and Future of the Turbine Engine for Civil Aircraft*.

Inquiries regarding these lectures should be addressed to Dr. Plesman Memorial Lecture Committee, 10 Kanaalstraat, Delft.

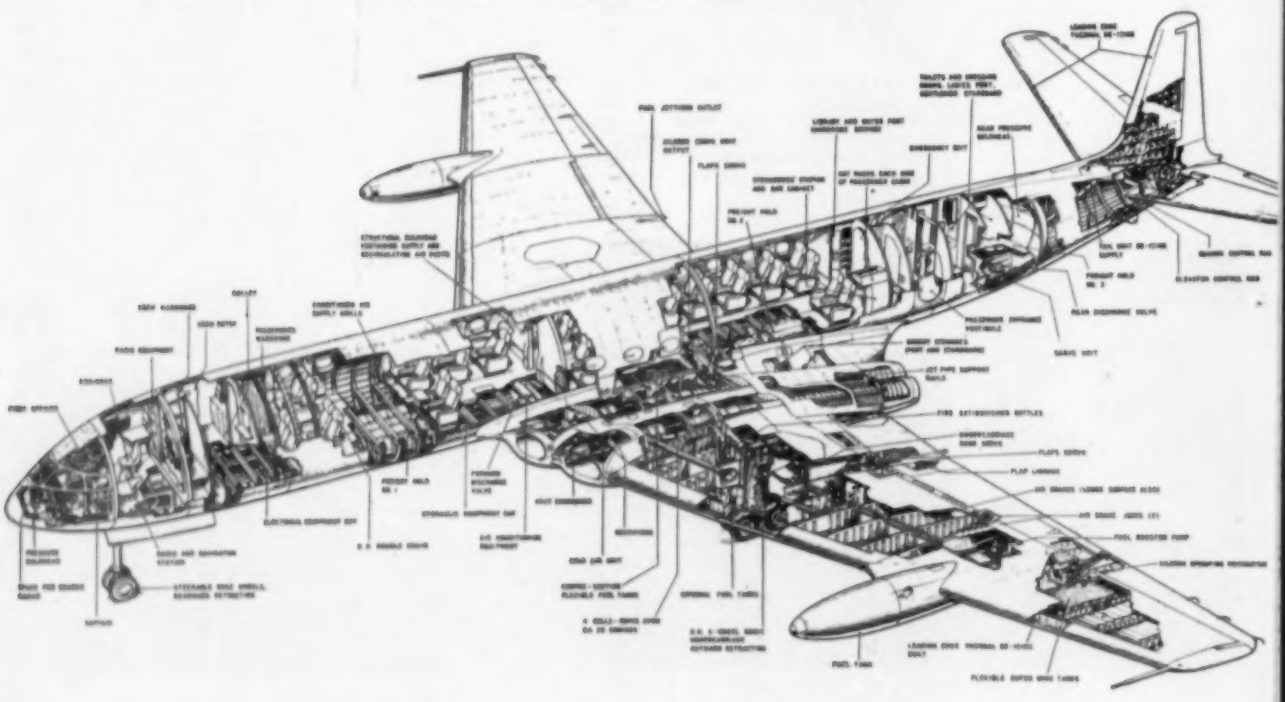
New Comet Data

INTERNAL features of the Series 4 Comet are revealed for the first time in the manufacturer's cutaway drawing reproduced below. Simultaneously, the de Havilland Aircraft Co. have published new, improved performance data based on the latest figures for the Rolls-Royce Avon R.A.29 engine and on the results of flying trials with the Comet 3 prototype. The Comet 4, or New Comet, is now credited with a stage-length of 2,945 statute miles when carrying its normal capacity payload of 16,400 lb (58-seat version; capacity payload of the 76-seat tourist version is 19,300 lb).

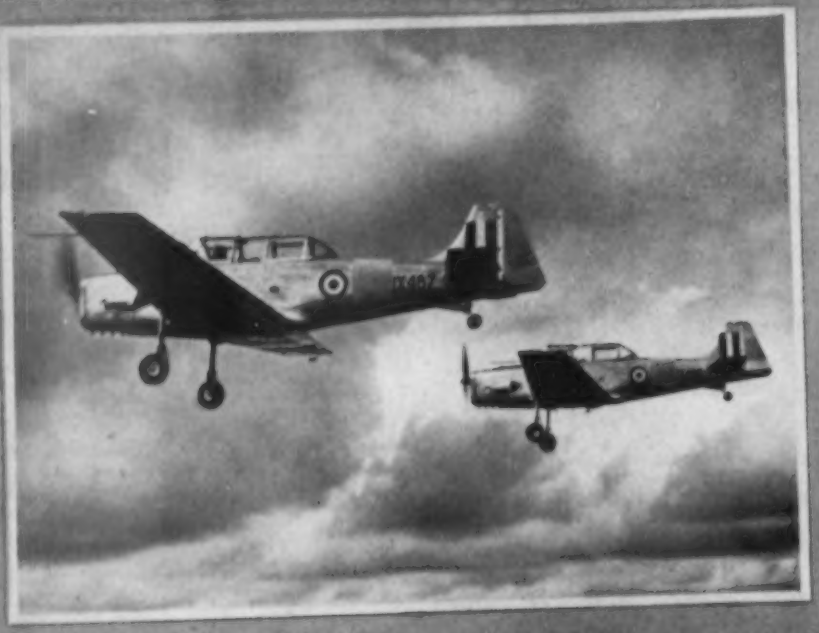
Design of the Comet 4 is stated to have been crystallized, and planning of its production is complete. The first production line is now moving, and deliveries will begin "in the latter part of 1958." Of structural development, the makers say that "many hundreds of tests on components large and small will culminate in a full-scale test of a Comet 2 fuselage in the water-tank at Hatfield." This test, to begin this year, will be followed in 1956 by a Comet 4 water-tank test, for which, it is stated, sections of the fuselage are now under construction. Delivery of modified Comet 2s to Transport Command should begin in the first half of 1956.

Use of the Comet 3 prototype, say de Havillands, should enable 80 per cent of the Comet 4 C. of A. trials to have been completed when the first Series 4 flies in 1957—by which time production will be well advanced. The Comet 3 will be fitted with R.A.29 Avons during 1956, and it is also intended to use Comet 2 airframes as test-beds for the new Rolls-Royce engines. By the time the Series 4 enters service Avon-powered Comets are expected to have completed some 4,000 hr of development flying. This figure is, of course, supplementary to the 30,000 hr of airline flying accumulated up to the time of the Comet 1's grounding in 1954.

***COMET 4** structural details are revealed for the first time in this official cutaway drawing. Integral wing tanks, bag-type centre-section cells and external "pinion" tanks provide a total fuel capacity of 8,760 Imp. gal. Both in external form and in layout of systems, the new Comet closely resembles the Series 3 prototype; "hidden" refinements, however, are numerous, and include re-design of the cabin structure, which is stressed for a differential pressure of 8¾ lb/sq in.*



FASTEST FARTHEST HIGHEST
Crew Comfort
VICTOR
Pilots sit side-by-side in its large comfortable cabin. They have a good view through windscreen panels which preserve the fine aerodynamic lines of this crescent-wing bomber's nose.
HANDLEY PAGE RADLETT LONDON READING



The HT-2 selected by the IAF for primary training is now in full production and deliveries can be made in batches. The Government permits the export of the aircraft.

The HT-2 Basic Trainer

The HT-2 has been tested by numerous pilots, whose reports show that the aircraft is a first-class trainer of *outstanding qualities* both in performance and workmanship.

HINDUSTAN AIRCRAFT LTD.

BANGALORE INDIA

American seamen helping to berth the aircraft carrier H.M.C.S. "Magnificent" at a North River pier in New York provide a picture of international co-operation. The carrier was part of a combined British and Canadian Naval force paying an informal visit to New York during the latter part of August.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

"Eagle's" Record

ON intensive training in the Mediterranean since May last, H.M.S. *Eagle* reached a peak on August 22nd when no fewer than 201 sorties were flown from the carrier's new angled flight deck—a record for any British carrier. During the same day *Eagle's* steaming mileage reached the 100,000 mark.

The ship is now based for a time at Gibraltar and will join the Fleet for autumn exercises.

Prize-giving in "Triumph"

AT a passing-out parade on board the aircraft carrier H.M.S. *Triumph*, now the cadet training ship, Rear-Admiral Sir C. Philip Clarke presented the Queen's Sword for the best all-round cadet to Cdt. N. F. Dingemans. The Communication and Aviation Prize went to Cdt. J. N. Stevenson.

Four Air Ministry Appointments

RECENTLY announced are the appointments of A. Cdre. F. W. Felgate, C.B.E., to be Director of Equipment (C); A. Cdre. W. A. Stagg, C.B.E., to be Director of Movements; A. Cdre. C. J. Nobbs as Director of Equipment (A); and A. Cdre. C. S. Moore, O.B.E., as Director of Intelligence (B).

A. Cdre. Felgate is an equipment specialist and, after serving as S.E.S.O. R.A.F. Mediterranean and Middle East was, in June 1951, appointed the first A.O.C. No. 206 Group in the Canal Zone.

A. Cdre. Stagg, who transferred to the R.A.F. from the Honourable Artillery Company in 1926, is also an equipment specialist. Since the beginning of 1951 he has been S.E.S.O. Flying Training Command, Deputy Assistant Chief of Staff (Logistics) at SHAPE and Director of Equipment (A).

A. Cdre. Nobbs also came to the R.A.F. in 1926. Among other appointments he has held are those of S.E.S.O. Transport Command, S.E.S.O. British Air Forces of Occupation, Germany, and A.A.S.O. No. 41 Group.

A. Cdre. Moore—who, until this Air Ministry appointment was made, was A.O.C. No. 66 (Scottish) Group, Home Command—passed out from Cranwell in 1930. He has served as a pilot and has taken a flying instructor's course at C.F.S. and attended the R.A.F. Staff College. Before taking over command of No. 66 Group he spent four years in America under the exchange posting scheme, on special duties in Washington and as R.A.F. representative at the U.S.A.F. Air University at Alabama.

No. 6 Squadron Visits Capetown

THE first M.E.A.F. unit to be equipped with Mk 4 Venoms, No. 6 Squadron—on detachment at Habbaniya—recently completed a 10,000-mile flight to Cape Town and back. During it, the record from Cape Town to Pretoria, previously held by the S.A.A.F., was broken by nine minutes. The 807-mile flight took 1 hr 23 min.

Commanded by F/L. M. Hobson, the Venoms thus completed Exercise Quick Return in 14 days. It was the first time that R.A.F. Venoms had travelled as far south as Cape Town, previous Quick Return exercises having terminated at Swartkopf. The extension afforded the pilots an opportunity of seeing something of the S.A.A.F. squadrons, and of observing their training methods.

At each of 13 South African stations visited, the Venoms gave displays of formation aerobatics. They were accompanied by a Valetta transport of No. 114 Squadron, carrying ground servicing crews and captained by F/L. McPherson. The Venoms flew two stages of their journey each day, refuelling at the first stop and refuelling and staying overnight at the next. All legs were flown at 40,000ft.

No. 6 Squadron, commanded by S/L. P. C. Ellis, D.F.C., has had a long association with the Middle East. During the last war it became known as the "Flying Tin-openers," in recognition of the pilots' work with their 40mm-gun Hurricanes against tanks in the Western Desert.

R.Aux.A.F Appointment

THE appointment is announced of S/L. F. B. Hamilton to command No. 3612 (County of Aberdeen) F.C.U. at Dyce, Aberdeen.

S/L. Hamilton is a Regular officer who in recent years has served with No. 208 Squadron in the Middle East and as adjutant of No. 616 (South Yorkshire) Squadron, R.Aux.A.F.

Prototype and early-production Gloster Javelins at Moreton Valance. One appears to have an anti-spin-parachute installation; another to have vortex generators on the fin. The Air Ministry is quoted as stating, last week, that Javelins will come into squadron service before the end of the year. Reference to the type was made in the Hoover report (page 340).

CIVIL AVIATION

CONVAIRS FOR S.A.S.

AN order for eleven Convair-liner 440s was announced by Scandinavian Airlines System on August 26th. The contract, which is valued at £3,200,000 (some £290,000 per aircraft), calls for delivery of the aircraft next spring, and follows the recent S.A.S. order for 14 DC-7Cs and spares at a cost of £13m.

The CV440 differs only in minor respects from the familiar Model 340. Most notable improvements will be a 5 m.p.h. increase in cruising speed and reduced cabin noise-level, due mainly to the use of rectanglar exhaust mufflers in place of the twin augmentor pipes previously employed.

The rôle of the S.A.S. Convairs will be to replace DC-3s on internal services. Explaining their purchase of piston-engined medium-stage aircraft at a time when other major airlines are showing unprecedented preference for turboprops, S.A.S. say that: "The average route distance in Scandinavia is approximately 250 miles . . . on such short distances the turboprop or jet has no advantage over the piston-engined aircraft in that the former have to attain a certain minimum flight altitude before their power plants operate efficiently."

Previously S.A.S. had been regarded as probable Viscount purchasers. The company's technical staff have frequently visited Vickers-Armstrongs' Weybridge works in recent years to study the Viscount. Orders from other operators, however, have swelled the Viscount backlog to the point where S.A.S. would have to wait two years for aircraft ordered today. Convair's ability to offer more favourable delivery terms results from their lack of a civil backlog, together with a production line kept open by military orders.

CORPORATIONS ADOPT SMITHS SYSTEM

BOTH the British Airways Corporations have specified the Smiths Flight System for their new aircraft. B.E.A. have chosen it for installation in their V.802 Viscount Majors, and the system will also be used on B.O.A.C.'s Mk 300 and 300 L.R. Britannias. Described by its makers as "the most advanced example of systems engineering yet made available on the civil instrument market," the Smiths Flight System provides 16 conventional instrument functions in seven standard-sized indicators. An illustrated description appeared in *Flight* for August 19th.

SINGAPORE'S NEW AIRPORT

KALLANG, which served as Singapore's international airport for 18 years, ceased civil operations at midnight on August 20th. The following day the new £2.3m airport at Paya Lebar was opened by the Secretary of State for the Colonies, Mr. Alan Lennox-Boyd, in the presence of 10,000 spectators. The Secretary of State, accompanied by Lady Patricia Lennox-Boyd, Sir Robert Black, the Governor of Singapore, Mr. F. Thomas, Singapore's Minister for Communications and Works, and other officials, flew from Kallang to Paya Lebar in a DC-3 of Malayan Airways.

At the opening ceremony, Mr. Lennox-Boyd traced the development of civil aviation in Malaya since the first recorded aeroplane flight there in 1913, "when a wealthy Chinese citizen of Singapore, Wellesley Wong, took to the air in a stringy, spindly machine, which, alas, dropped to pieces." He was glad to see that all races were taking part in today's developments and noted that Asians represented only 22 per cent of the passengers carried on the pioneering pre-war internal services of Wearne Bros., whereas today they comprised 82 per cent of the passengers carried by Malayan Airways.

As recorded below, Singapore's new international airport at Paya Lebar has now taken over from Kallang. Its single runway has a length of 8,000ft—2,000ft longer than Kallang's main runway.

BREVITIES

THE president of United Air Lines, Mr. W. A. Patterson, said in San Francisco last week that his company planned to order 25 jet transports—Boeing Stratoliners or Douglas DC-8s—by the end of 1955. United, who expect to have the aircraft in operation by the summer of 1961, believed that American Airlines and T.W.A. would place orders of similar size "and probably with the same aircraft manufacturer." It was reported recently that National Airlines had placed a firm order for six DC-8s.

* * *

An order, valued at £4m, for five L.1049H Super Constellation freighters is announced by Slick Airways. To be delivered in January 1957, the aircraft will be used for scheduled all-cargo services on American domestic routes.

* * *

The Air Registration Board has announced the publication of Section C, Issue 3, of British Civil Airworthiness Requirements; this section deals with requirements for engines and propellers. A revised Contents List (Issue 24) is also announced.

* * *

The Brazilian airline VARIG inaugurated regular services between New York and Rio de Janeiro on August 5th. Flights are operated by L.1049G Super Constellations, stopping *en route* at Ciudad Trujillo and Belem.

* * *

Provisional shareholders in Air Terminals, Ltd., the company which will operate the projected new London air terminal building in the Cromwell Road, have been announced by British European Airways. Eighty per cent of the shares will be held by B.E.A., B.O.A.C. will hold 10 per cent, Aer Lingus five per cent and the British Independent Air Transport Association the remaining five per cent.

* * *

Important developments in Communist Chinese air transport are forecast in reports from Peking. Particular stress will be laid on the establishment of air services to countries of south-east Asia.

* * *

Middle East Airlines became the 70th active member of I.A.T.A. on September 1st. Based at Beirut, the airline operates to Cyprus, Egypt, Iraq, Jordan and Saudi Arabia.

August 21st saw the first of many Viscount landings in the West Indies, when B.W.I.A. Viscount flagship arrived at Piarco Airport, Trinidad. Also on the airport at the time were an R.A.F. Hastings and Canberras of 139 Sqn.

42 Passengers and their personal luggage . . .

plus 3 private motor cars . . .

plus 12 tons of freight . . .

and all *aboard the* **Universal**

The Universal is the civil version of the Beverley which is in production for the Royal Air Force.

Blackburn and General Aircraft Limited. Brough, E. Yorks

Tucker "Pop" Rivets

and the *Vickers Viscount*

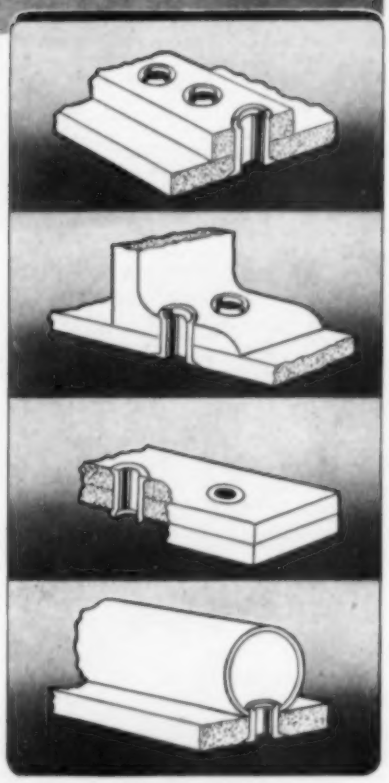
In the same way that the record breaking efficiency of the Vickers Viscount has justified the confidence of operators in all parts of the globe, so has the 'POP' Riveting system justified the confidence of Vickers-Armstrongs and the many other manufacturers who use it extensively in the assembly of their aircraft.

Requiring only one operation by one operator to set or clench the rivet, this modern system of riveting eliminates errors in setting, prevents distortion of the structure and enables rivets to be set in positions inaccessible by other methods.

See this modern system of riveting at the Exhibition of the Society of British Aircraft Constructors at Farnborough.

Stand No. 198.

Photograph of 'Viscount' by permission of Vickers-Armstrong (Aircraft) Ltd.



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CIVIL AVIATION . . .

Pakistan International Airlines announce that Mr. Maurice McGregor is relinquishing his post "in favour of a Pakistan national," whose name has yet to be announced. Formerly overseas manager of Canadian Pacific Airlines, Mr. McGregor joined Pakistan International as general manager some 16 months ago when the airline was in process of formation.

* * *

During the first six months of the year, the British Travel and Holidays Association reports, 52 per cent of American visitors to Britain came by air. American air travellers to Britain last year totalled 97,000, compared with 106,000 sea travellers.

Traffic results for the financial year ended June 30th, 1955 have been announced by Trans-Australia Airways. Passenger traffic increased only slightly—685,000 passengers were carried, 4.3 per cent more than in the previous year—but freight and mail traffic went up by more than 12 per cent.

* * *

Hunting-Clan Air Transport have doubled the frequency of their "Africargo" York freighter service, previously operated once weekly between the United Kingdom and East Africa. Flights now leave Manchester and London on Tuesdays and Saturdays, arriving at Nairobi on Thursdays and Mondays. Since the inauguration of the service in June all outward flights have been heavily booked, and Hunting-Clan say that the increase in frequency results from the strong support received from commercial houses, forwarding agents and other shippers.

FROM THE CLUBS

PRIVATE pilots' licences have recently been gained by the first two members of the A.S. Flying Club to be trained *ab initio* by the club. The members are Stan Clarke (treasurer) and Basil Fryer (secretary), who are employees of Armstrong Siddeley Motors (as, indeed, are all members of the club). The club operates a Tipsy B Trainer and is based at Baginton; the clubhouse there has recently been redecorated. Subscriptions and flying charges are 2s 6d per week and 30s per hour respectively, hangar rent being paid by the Armstrong Siddeley company.

THE "re-play" of the Vintage Aeroplane Club's rally took place on Sunday, August 21st at Denham, Ron Gillman reports, but morning mist (which lifted into low cloud) again prevented many competitors from getting through to the aerodrome.

However, nine machines got away after lunch on the first leg of the course, from Denham *via* Fleet to Portsmouth, where a landing was to be made. There, the competitors had twenty minutes to plot their course for the return journey—which had been unknown to them until that time, and which was then indicated by a skeleton map only. The homeward leg *via* Winchester and Hook proved the more difficult flight, several navigators failing to find the turning points at all. Point penalties were given for early or late arrivals at the various turns, for bad airmanship and poor aircraft-handling. A right-hand circuit sign in the signals area at Portsmouth caught out a number of pilots and one, having flown round the field left-handed, proceeded to land with a flourish down-wind. The organizers were caused some embarrassment when it was revealed that the winner was Denham's own C.F.I., Wilbur Wright, with 162 faults; while the second man was Mr. Castle of the Warwickshire Aero Club with 228 faults, and third Mr. Cosmelli in the Spartan with 232½. The winner took possession of the Chiltern Hills Trophy, and the first three entrants received cash prizes.

THE secretary of the Home Counties Flying Group reports that his recent news that the group was to move from Denham to Panshangar was based on a misunderstanding. The group's aircraft continues to use Panshangar for maintenance purposes, but Denham remains as its permanent base.

AMONG the record flying times logged for the month of July were those of the Yorkshire Aeroplane Club at Sherburn-in-Elmet (250 hr), Yeadon Aero Club (347 hr), and Fair Oaks Aero Club (621 hr).

FOLLOWING the success of the Cambridge Private Flying Group's first treasure hunt, held at Marshall's Airport on August 7th, it is hoped to organize a similar event before the end of the summer. Gordon Baylis, who recently gained his P.P.L., won the treasure hunt, and Ivor Barnes, a student pilot who went on to win the spot landing contest, was placed second. A height-judging competition was won by Mrs. D. Hancock. Prizes were presented by Capt. A. C. Taylor, president of the group, which now has a membership of over 90.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

The P.1 at Farnborough

I NOTE that the English Electric P.1 Fighter will not be displayed at Farnborough on September 9th, 10th and 11th as it is undergoing development trials, and cannot be spared.

Surely, if it can be spared for private display as stated, could it not be shown to the public on the last day? There are many who would wish to see Britain's No. 1 Fighter. Who is to blame, the Ministry of Supply—the usual red tape—or the manufacturers?

Newbury, Berks. A. W. HILL.

Ancient Customs

ANOTHER example of the archaic manners and customs of H.M. Customs is that in 1955, after 36 years of air transport, they continue to refer to their officials at airports as "waterguards"!

London, S.W.3. GEOFFREY DORMAN.

Civil-aviation Old Stagers' Association?

OUR own impending retirement, coupled with the retirement or impending retirement of so many old friends who have been connected with the development of civil aviation at home and overseas since early days, has led us to wonder whether the time is not ripe for the formation of some body which would enable the old stagers of civil aviation to keep in touch with one another, meet from time to time, swap yarns and deplore the fact that spirit of civil aviation is no longer what it was in our young days!

Air transport has now been going for approximately 35 years and inevitably we have reached the stage where many of those who came into it in one capacity or another in the early days have now reached, or are rapidly approaching, the age of retirement. Some of us, in one capacity or another, may be able to retain contact with aviation affairs, but to others retirement may well mean the severing of all ties with aviation and the loss of contact with old friends and acquaintances who have shared the heat and burden of the day.

I am not suggesting an association composed entirely of old "has beens," which would gradually lose all its members as they acquired wings of their own (perhaps an optimistic thought!), but would rather see a body for which the qualification for membership consisted of not less than 25 years' continuous work for the cause of civil aviation in any capacity. This would include not only those who had reached the retiring age, but also those still actively connected with civil aviation; and the minimum qualification of 25 years' service while giving a founder membership confined to those who had joined the ranks of civil aviation before the 1930s, would add a fresh class of those eligible for membership each year.

I hope that this letter may reach the eyes of many old friends and that among them one will be found with sufficient time and enthusiasm to organize such an association. If he would like to get in touch with me [British Aviation Insurance Co., Ltd., 3-4 Lime Street, London, E.C.3], I shall be very glad to give him a preliminary list of those whom I know to be eligible for membership, and to help him in any other way within my capacity.

London, E.C.3. A. G. LAMPLUGH.

Water Injection in 1917

THE use of water injection was being developed in the summer of 1917 by Maj. Hopkinson (a Cambridge professor?) at Martlesham Heath. "Hoppy" was killed there in the autumn of that year.

In World War II the idea of water injection was adopted 100 per cent.

Incidentally, in June 1917, a D.H.4 with B.H.P. engine failed when being tested at 17,000ft. Water got into the lubrication system and oil into the cooling system.

Detroit, Michigan. STANLEY UDALE.

HERE AND THERE

Do 27 Flying in Germany

THE Dornier Do 27 single-engined two-seater, apparently a development of the Do 25, as built and flown in Spain, has recently been air-tested at Dornier's own airfield at Oberpfaffenhofen, near Munich. It is fitted with an American Continental engine of 240 h.p.

Satellite Bombers

OFFICIAL announcements confirm that jet bombers are now being built in Czechoslovakia and Poland. The Czech-built bombers are to be shown at the next Czechoslovak Aviation Day fly-past near Prague.

Offshore Trawler

THE inventor of the helicopter scoop net, Lt. Cdr. J. S. Sproule, R.N., has travelled to America at the invitation of the Navy Department in order to demonstrate his invention to the U.S. Navy and various Service departments and officials.

Jackpot

A SURPRISE awaited a Gibraltar-bound B.E.A. Viscount passenger, Mrs. Susan Burrough, at London Airport on August 24th. She was told by B.E.A.'s station manager, Mr. T. LaPraik, that she was the ten-millionth passenger to have been flown by the Corporation since its inception in 1946. On behalf of the chairman, Mr. LaPraik handed her a cheque in refund of her fare.

Coast-to-Coast for $80

BECAUSE the distances and currencies involved are unfamiliar, the relative cheapness of air travel in North America is not readily appreciated in Europe. Few eyebrows would be raised in this country by last week's announcement that American Airlines and United Air Lines were seeking C.A.B. approval for a 20 per cent reduction in transcontinental air-coach excursion (30-day) fares. Yet the proposed new rates will make it possible to fly from New York to Los Angeles and back, a distance of nearly 5,000 miles, for only $160 (£56). This is equivalent to a London-Paris off-peak tourist return fare of five guineas—compared with the £12 (excluding taxes) actually charged.

NOT YET CONVERTED from its "helicopter" to its "aeroplane" configuration, but already flying, as shown—the Bell XV-3 convertiplane. The first flight was made a few days ago by Bell's chief helicopter pilot, Floyd Carlson. In cruising flight the machine should be "as fast as a DC-3."

FARNBOROUGH ON RECORD

"Flight" next week (September 9th)—the Farnborough Report Number—will contain first-hand fully illustrated descriptions of the flying and the new aircraft seen at the opening days of the Show; these will be supplemented by articles on other topics, and by regular features.

"Flight" for September 16th—the Farnborough Review Number—will offer a detailed appraisal of the week's flying and technical trends, with further descriptions of the static exhibits, plus regular features and articles on other subjects.

Both issues will be priced at 1s 6d.

The "Tremendous" B-57

AFTER watching a flight of a Martin B-57 (English Electric Canberra licence) from an airfield near Syracuse, New York, on August 26th, Mr. Averill Harriman, the Governor of New York, described it as "tremendously impressive." He added that he was sorry that the Air Force had so few B-57s, and blamed a decision of the Republican administration—later revoked—to cut Air Force funds. It had caused "loss of time and momentum."

Helicopter Designations

THE manufacturers have decided that in future Westland helicopters, including civil types, will be called by their Service names rather than by the familiar S-51 and S-55 designations; these two, therefore, will be known as the Dragonfly and the Whirlwind.

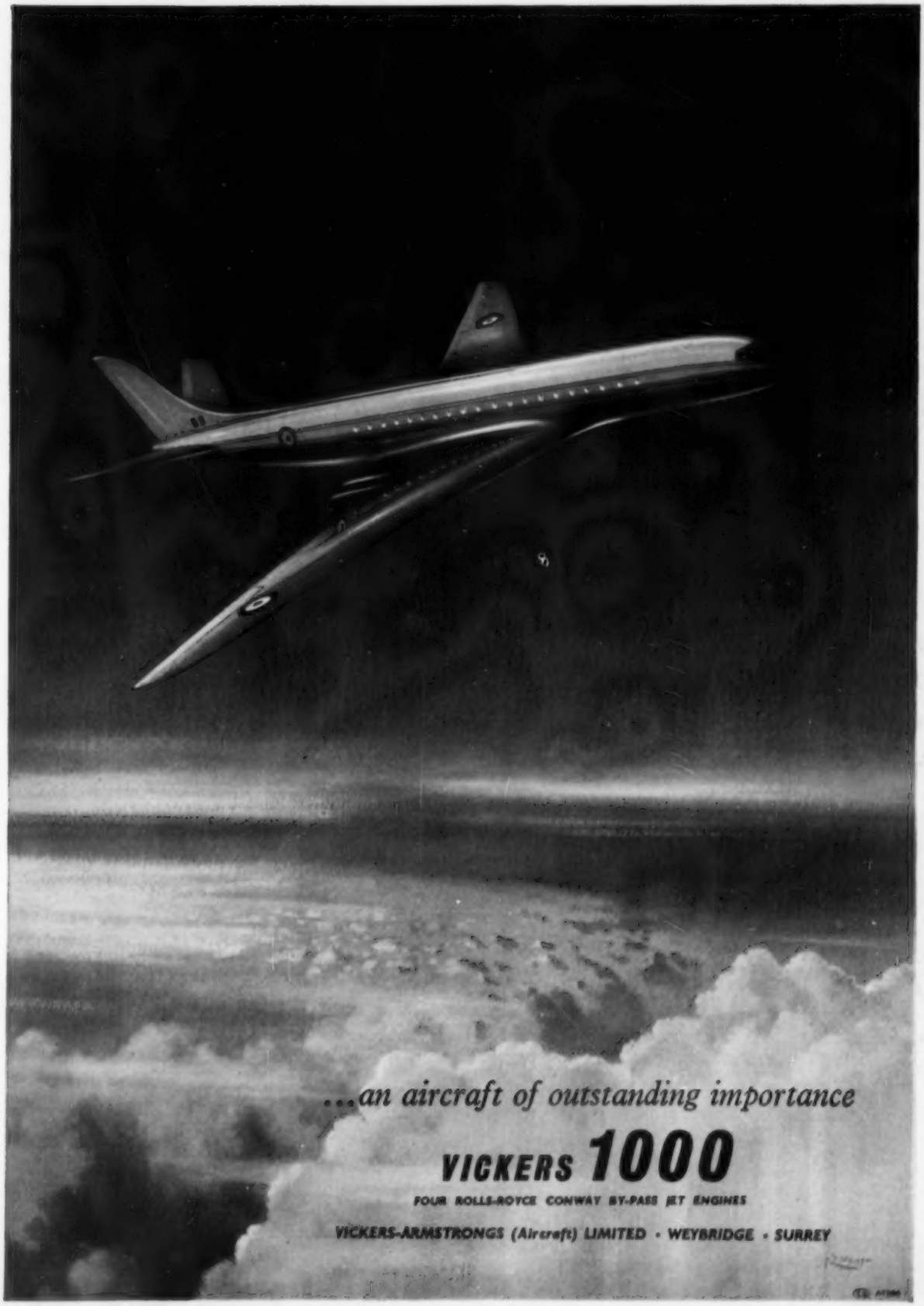
Pictorial Maintenance

THE new pictorial maintenance schedule developed by Field Aircraft Services, Ltd., for the servicing of Hunting Clan's Viscounts (described in *Flight* on August 19th) has now been in use for three months. The scheme went into operation smoothly and is working very well, the only modification being that individual component groups are signed for instead of whole sheets at a time, thus ensuring continuity through shift change-overs. The inception and development of the new schedule was made possible by the wholehearted co-operation of the Air Registration Board.

SCENE - STEALER: Here seen eclipsing even the Victor V-bomber (lurking distantly and darkly beneath its cockpit sunshade at Radlett) is the first Handley Page Herald, resplendent in the livery of Queensland Airlines. A first-flight news-item and picture appear on page 338.

American Team for Woomera

RADIO AUSTRALIA reported last week that a big team of American military rocket specialists is shortly to visit the Woomera range. This was announced by the Minister for Supply, Mr. Beale, who has just returned to Sydney after inspecting atomic energy establishments in Britain, Canada and the U.S.A. He explained that, "because of America's powerful economy and the prevailing industrial philosophy favouring the early mass-production of guided missiles, there is some difference of opinion with Britain and Australia on the best method of approach. However, I have been constantly struck by the great similarity between America, on the one hand, and Britain and Australia, on the other, in organization, equipment, general thinking and likely development."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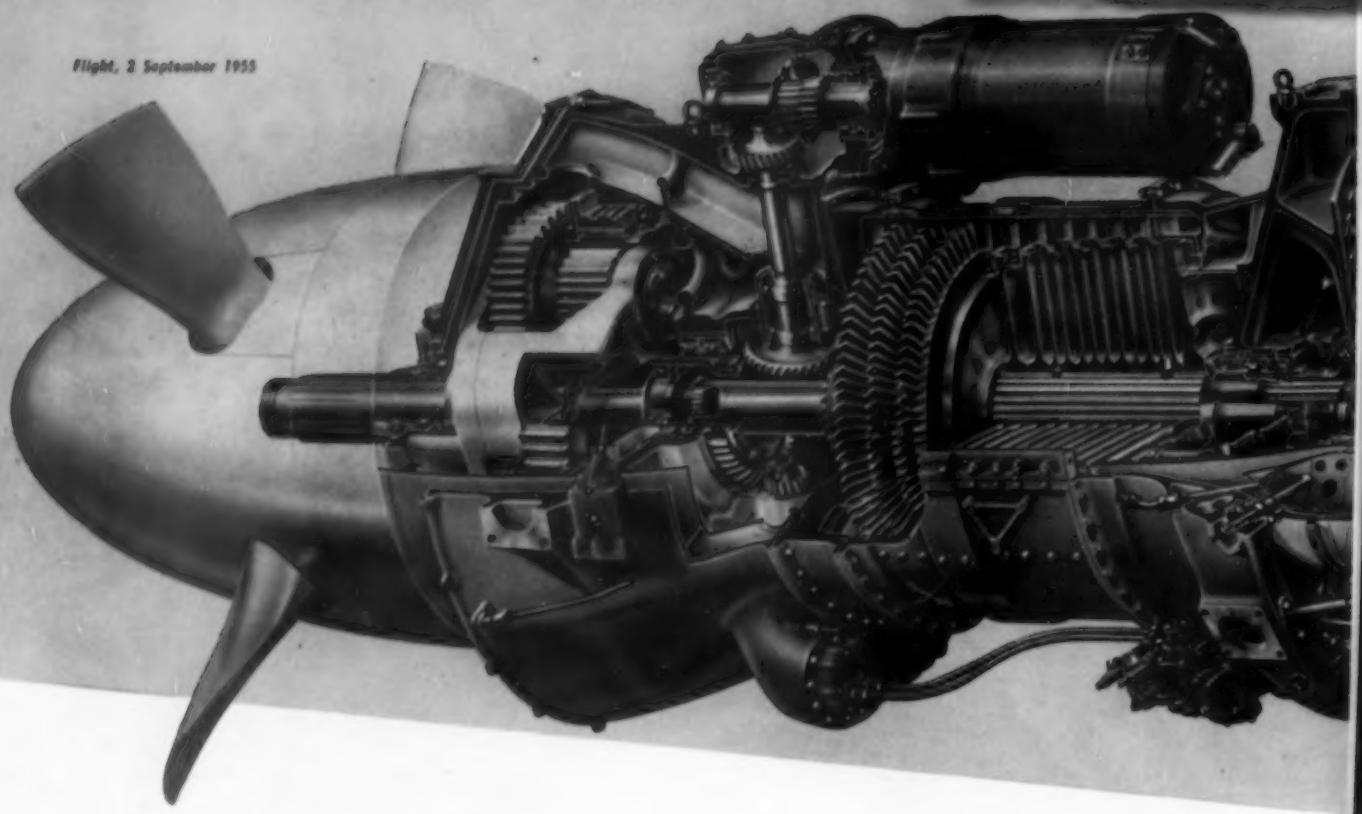


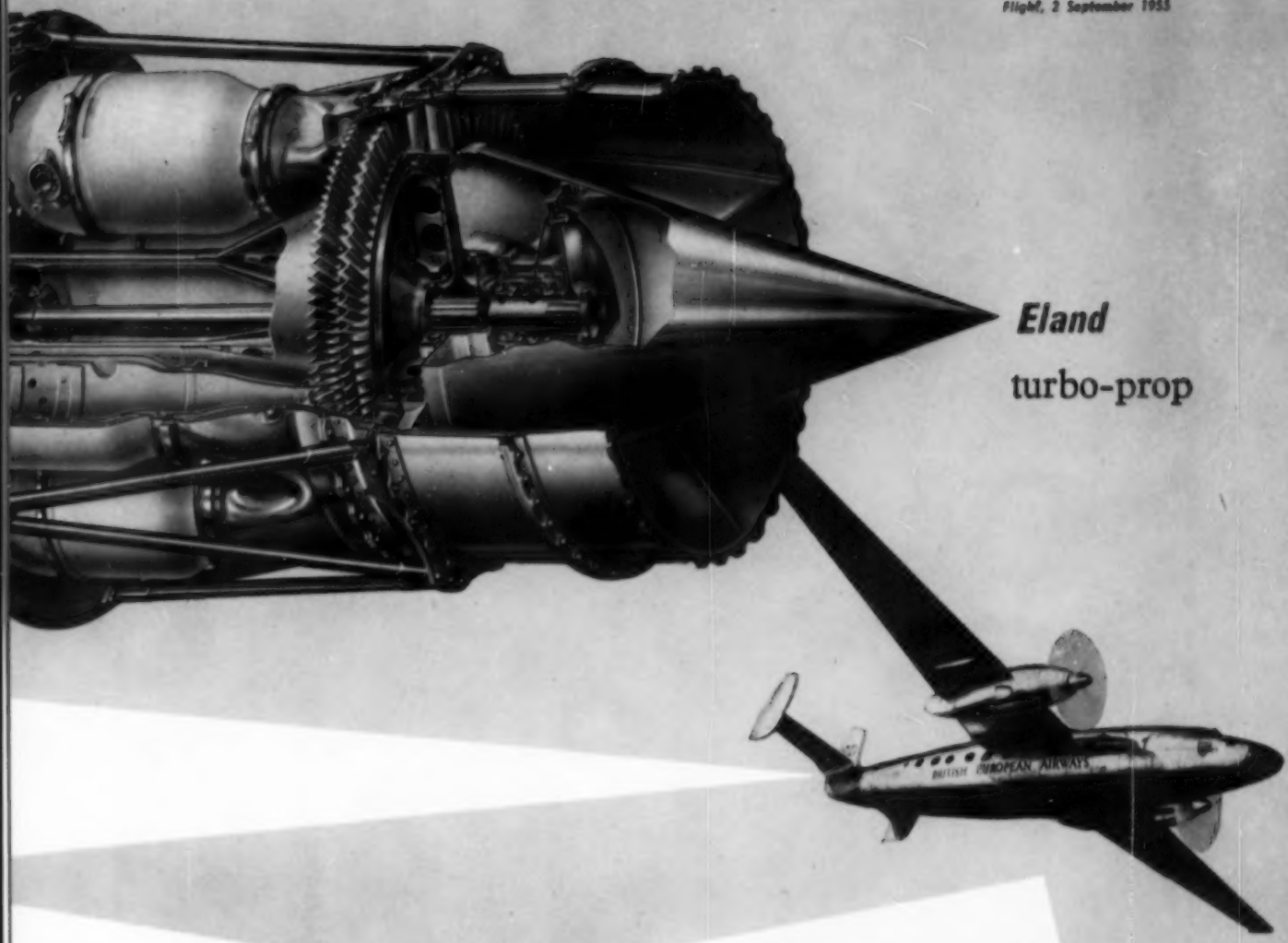
see **NAPIER** on stand G at Farnborough

With the **Eland** turbo-prop Napier offer a range of gas turbine engines to meet a wide variety of needs in world air transport. These engines feature reliability at all altitudes, simple and safe automatic control, high power/weight ratio, simplicity of maintenance and economy of fuel consumption. The 3,000 e.h.p. **Eland** has reached the Type Test stage, and a 4,000 e.h.p. version is now running. Still higher powers are on the way.

Napier are specialists in the application of the gas turbine to rotary wing aircraft and have a series of engines designed specifically for this purpose.
A particular version of the **Eland** incorporating an auxiliary compressor for the tip-powered rotor system will be used in Fairey's large transport helicopter—the Rotodyne.

Napier are also working with Hunting Percival in the development of the **Oryx** 750 gas h.p. turbo-gas generator as a power unit for the P74 helicopter—an entirely new form of helicopter propulsion which eliminates all mechanical transmission.

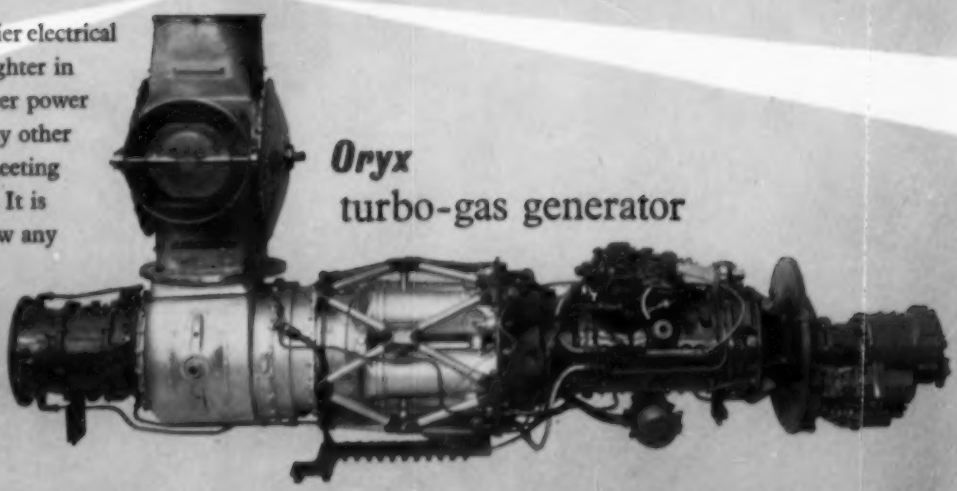
Partners in Progress with The ENGLISH ELECTRIC Company Ltd · D. NAPIER & SON LIMITED · LONDON, W.3.



Eland

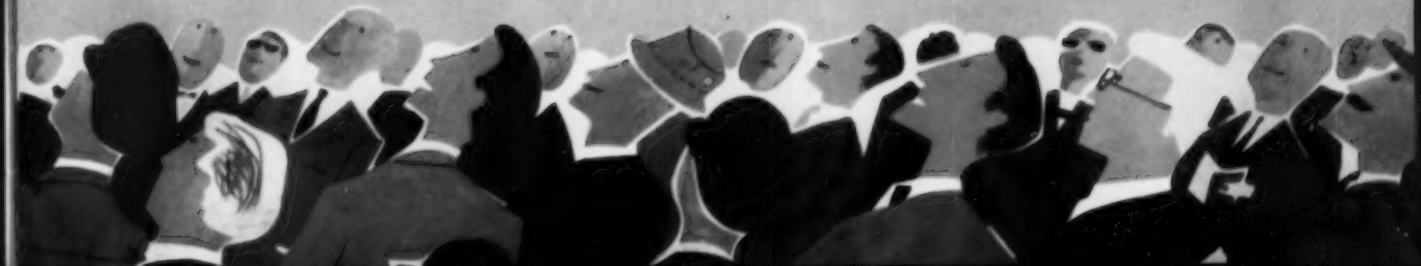
turbo-prop

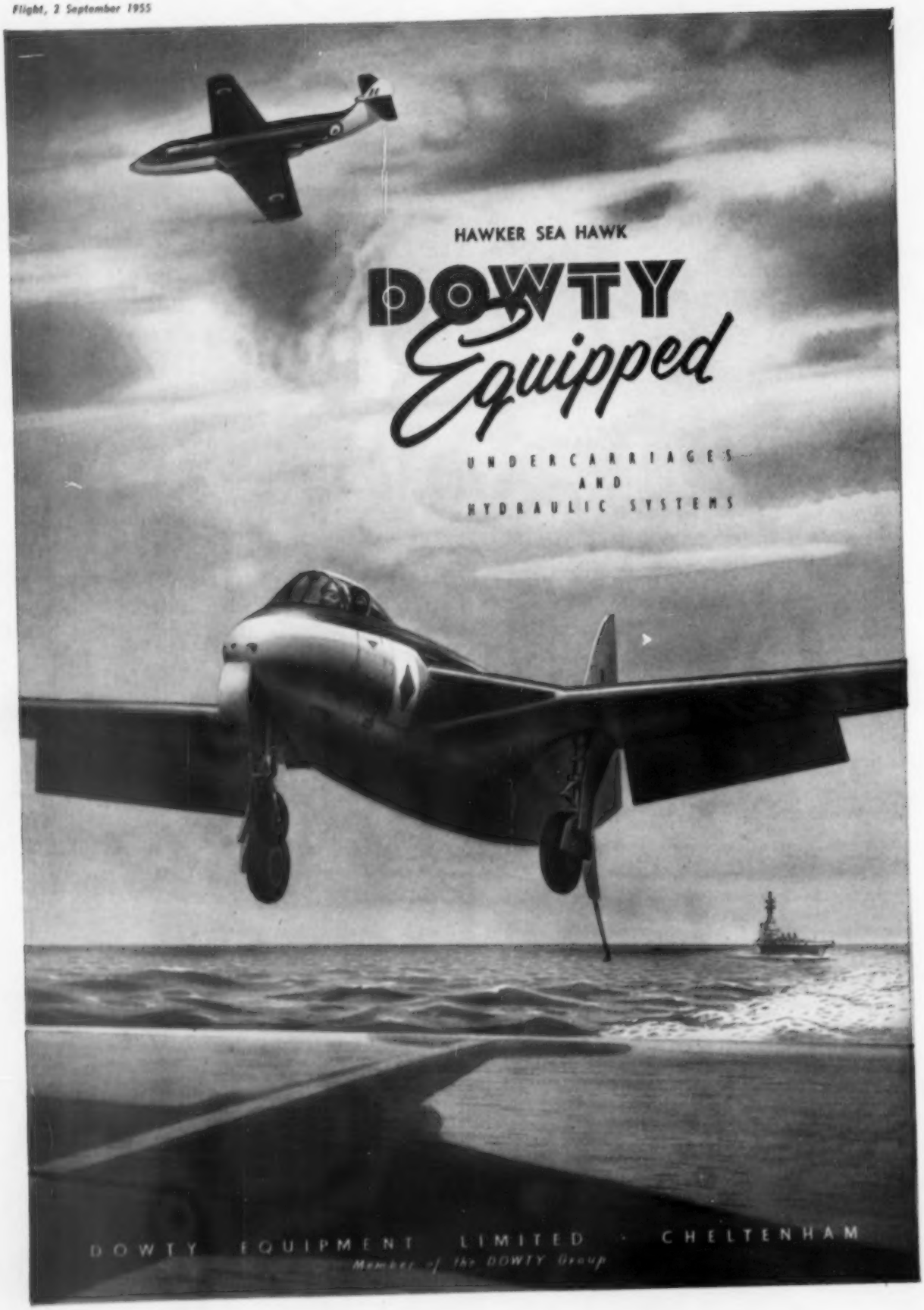
Spraymat, the Napier electrical de-icing system, is lighter in weight and has a lower power consumption than any other method capable of meeting design requirements. It is sprayed on, can follow any contour, is easily repaired and resists sand, rain, fuels and hydraulic fluids. It can be applied to aircraft in service or to new designs.



Oryx

turbo-gas generator

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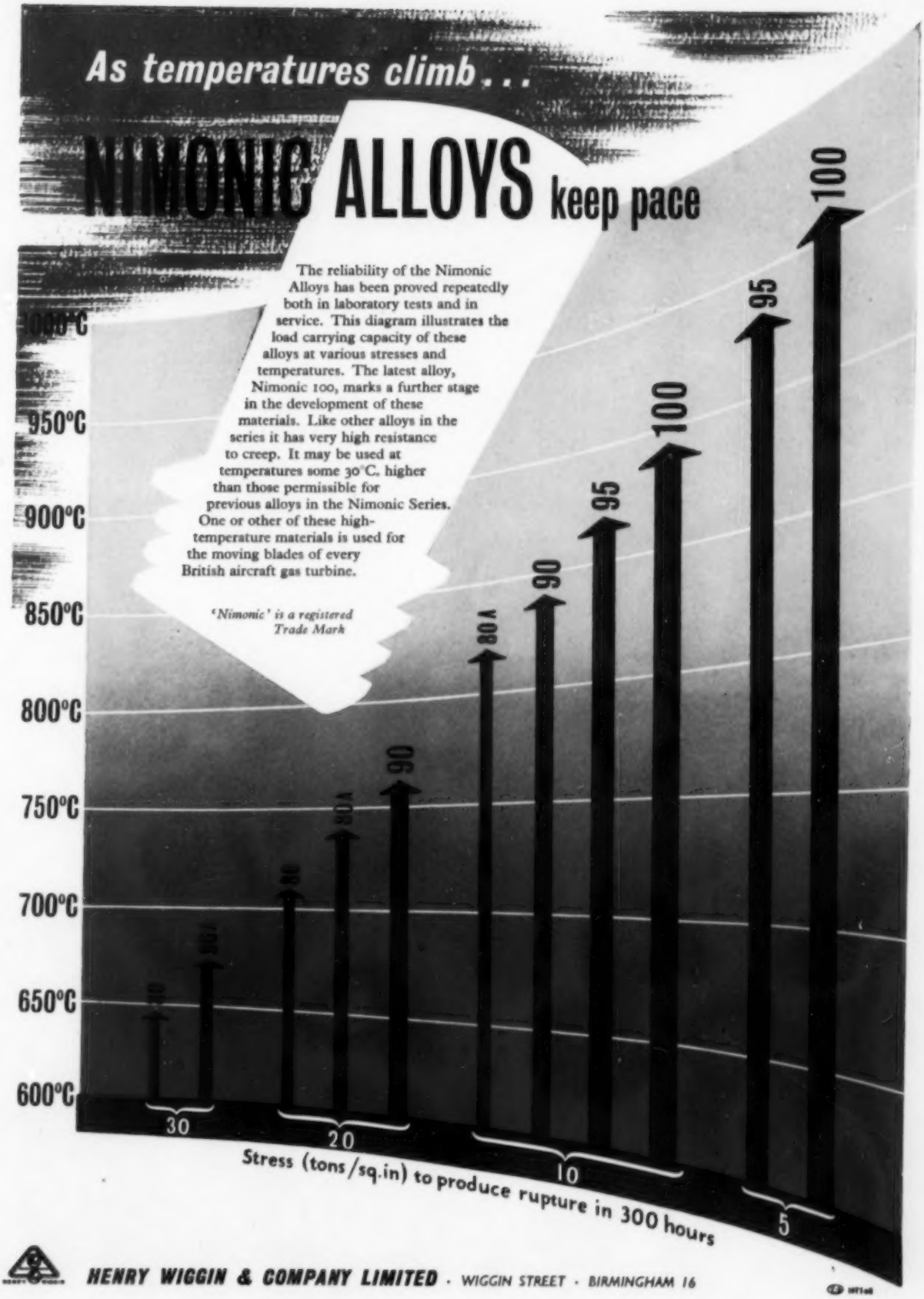
As temperatures climb . . .

NIMONIC ALLOYS keep pace

The reliability of the Nimonic Alloys has been proved repeatedly both in laboratory tests and in service. This diagram illustrates the load carrying capacity of these alloys at various stresses and temperatures. The latest alloy, Nimonic 100, marks a further stage in the development of these materials. Like other alloys in the series it has very high resistance to creep. It may be used at temperatures some 30°C. higher than those permissible for previous alloys in the Nimonic Series. One or other of these high-temperature materials is used for the moving blades of every British aircraft gas turbine.

'Nimonic' is a registered Trade Mark



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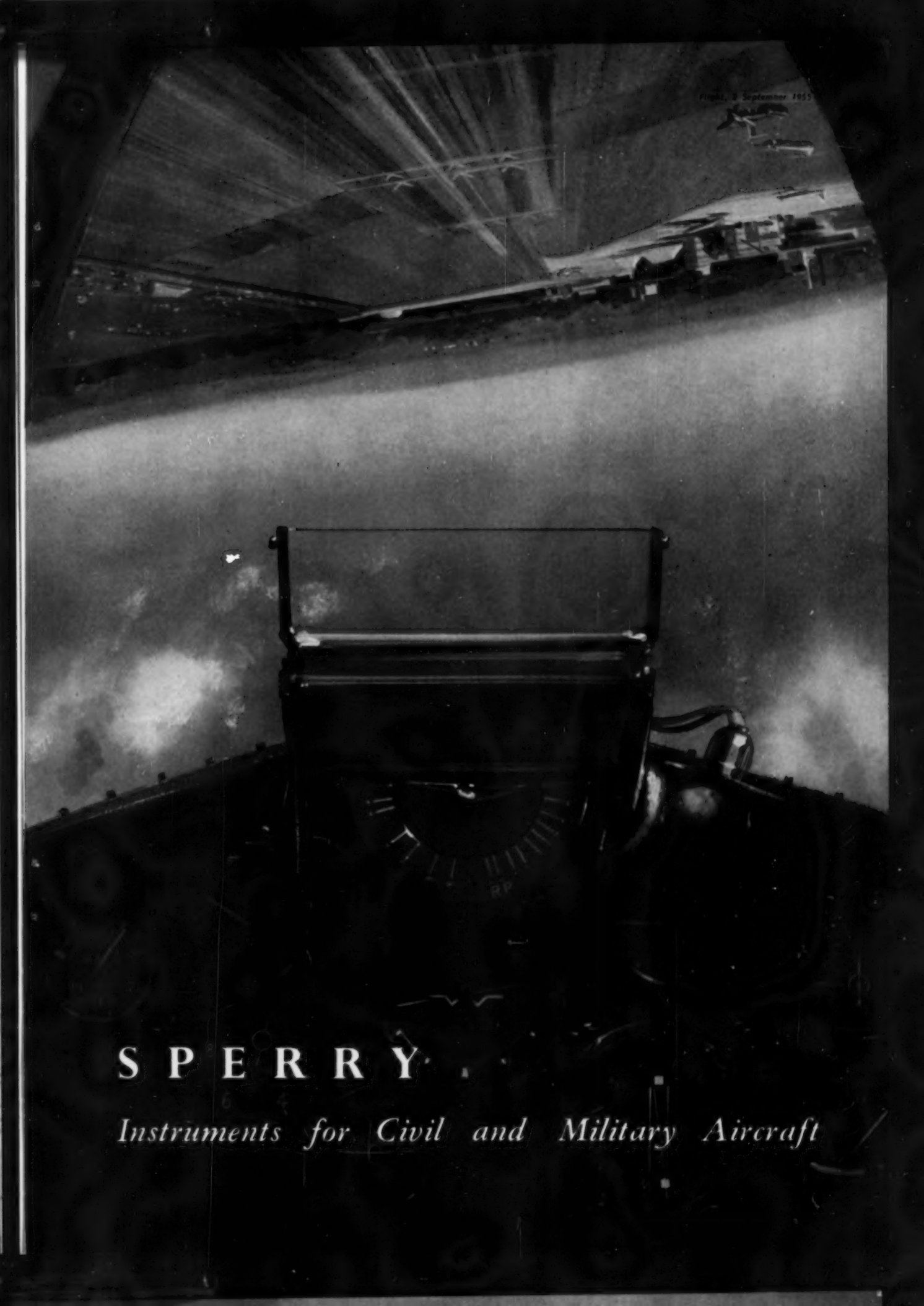

SPERRY
Instruments for Civil and Military Aircraft

WESTLAND
IN SERVICE FROM THE ARCTIC TO THE TROPICS

BRITISH AIRCRAFT 1955

THUS far in 1955 we have seen a growing accord between nations, a more liberal approach to commercial affairs, and impressive increments in passenger and freight traffic along world airways. It is fitting, therefore, that new transport machines should dominate the British aircraft of the year, the more so as they bid fair to establish themselves in many lands. These promising machines—the Handley Page Herald and Scottish Aviation Twin Pioneer—have been designed for profitable operation in exacting climates and terrains, and their Alvis piston-engine power implies no weakening of Britain's faith in the gas turbine, at present for most, and eventually for all, commercial applications. That faith, indeed, becomes daily firmer with ever-mounting orders for the Dart-powered Vickers-Armstrongs Viscount and widening experience with the Bristol Britannia (Proteus). Staunch as ever is our national conviction—implicit in the Avon-engined de Havilland Comet and Vickers-Armstrongs 1000 (Rolls-Royce Conways)—that the pure-jet and by-pass jet will jointly command a prime position on arterial routes. As to fixed wings, so to rotary blades is the gas turbine being matched and tailored, and upon such units as the Napier Oryx, Gazelle and Eland, and the range of smaller Blackburns, British prestige in wide and rewarding fields may ultimately depend.

To an increasing degree is any new aircraft made or marred by its power plant; and this, of course, is as true of fighters and bombers as it is of civilian machines. At opposite ends of the supersonic day-fighter scale we have the English Electric P.1, with superimposed reheat turbojets delivering (it may be supposed) a thrust far into the 20,000 lb regime, and the miniature Folland Gnat, the world's first light jet fighter, with its single Bristol Orpheus of less than 5,000 lb output. The twin-Sapphire Gloster Javelin and twin-Avon D.H.110 are supreme among heavy day-and-night fighters, and unmatched in the all-important respect of altitude performance are our V-bombers—the Vickers-Armstrongs Valiant (Avons), Avro Vulcan (Olympus), and Handley Page Victor (Sapphires). Following the lead of Westland's Python-Wyvern, our anti-submarine aircraft, the Short Seamew and Fairey Gannet (respectively with Armstrong Siddeley Mamba and Double Mamba) are showing the world how the turboprop offers unique advantages for Naval service.

True, in some directions our technical development has lagged, notably in the full-scale investigation of supersonic phenomena; but the situation is now well on the road to redress with the construction of such machines as the Fairey F.D.2 delta. The Rolls-Royce Bedstead, the prone-pilot and jet-deflection Meteors, the flying test-beds for new turbojets and secret rockets—all these are tangible evidence of a resolve to direct available resources and talents to the most rewarding ends.

The winged lion is valiant.

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT, LTD.

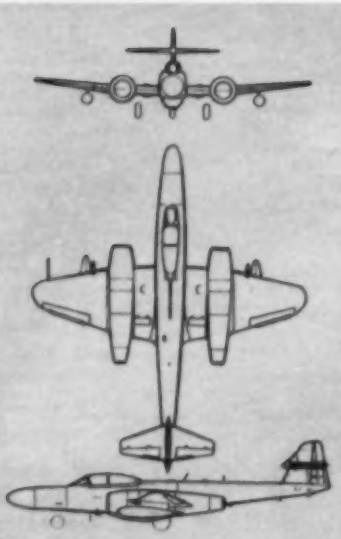
Baginton, near Coventry, Warwicks. Telephone: Tollbar 2261

***Meteor* Night Fighters** Development of the Gloster Meteor single-seat day intercepter into a two-seat radar-equipped night fighter was undertaken several years ago by Armstrong Whitworth. The first model, the N.F.11 of 1950, had the long-span wing of the photographic reconnaissance Meteor; a lengthened nose to house the radar; tandem cockpits, with an enclosure similar to that of the T.7 trainer; and the tail of the F.8 day fighter. The four 20 mm guns were transferred outboard of the nacelles. The N.F.13 (chronologically the succeeding mark) was similar, but was equipped for overseas operation; and the N.F.12, which materialized in April 1953, had a lengthened nose, housing improved radar, and a faired tail "bullet," which effectively increased fin area. The N.F.14, tested late in 1953, is a similar machine but has a wholly new clear-view cockpit enclosure and other refinements. A ventral fuel tank of 180 gallons capacity is normally carried, and two under-wing tanks of 100 gallons each are optional. Meteor night fighters have been used for the experimental launching of guided missiles, and the type will remain as the standard R.A.F. night fighter until the introduction of the Gloster Javelin. Other countries supplied are France, Belgium and Denmark.

Sea Hawk The Sea Hawk, a Hawker-designed carrier-borne fighter developed from the P.1040 (Hawker's first jet) has been extensively produced and developed by Armstrong Whitworth, both for the Royal Navy and under NATO off-shore contracts. The latest variant is the F.G.A.4, which has attachments for underwing bombs, rockets and other offensive stores, in addition to the built-in armament of four 20 mm guns. The F.G.A.4 has powered ailerons and is an exceedingly popular machine among pilots of the Fleet Air Arm by reason of its docility, comfort and quietness. In recent months a Sea Hawk has been flying at Bitteswell equipped with vortex generators on the tailplane to ascertain the longitudinal stability characteristics at high Mach numbers. This research is being undertaken to raise the maximum speed—at present about 630 m.p.h. The Rolls-Royce Nene turbojet, of some 5,000 lb thrust, is installed amidships and takes in air through wing-root intakes. A unique feature is the bifurcation of the outlet. A sting-type deck-arrester hook is fitted, and the wings are power-folded from a point slightly outboard of the intakes.

It may be mentioned here that large quantities of Sapphire-powered Hawker Hunters (see page 372) are also being produced by Armstrong Whitworth.

Prone-pilot Meteor To investigate the possibilities of a prone piloting position a Meteor F.8 has been converted by Armstrong Whitworth to incorporate this feature in a special elongated nose. Aft is a normal cockpit with a "safety" pilot. The prone-pilot Meteor has flown extensively both from Baginton and Farnborough, and is affording invaluable experience of pilot reactions to high accelerations.

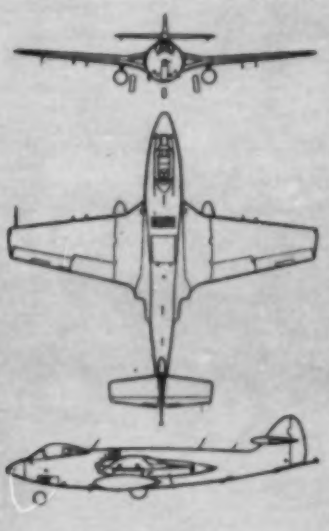


Power Plant	Two Rolls-Royce Derwent
Span	43ft
Length	49ft 11in
Gross weight	20,000 lb approx.
Max. Speed	590 m.p.h. approx.

Above, Meteor N.F.14

Below, Sea Hawke F.G.A.4

Power Plant	Rolls-Royce Nene
Span	39ft
Length	40ft

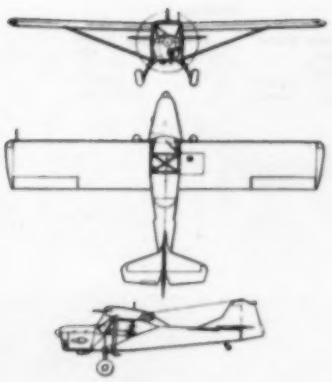


AUSTER AIRCRAFT, LTD.

Rearsby Aerodrome, near Leicester
Telephone: Rearsby 321

A.O.P.9 As the new standard air observation post of the British Army, the A.O.P.9 (Blackburn Bombardier 203 engine) represents a significant advance on the many hundreds of earlier Auster A.O.P.s supplied to air forces and armies throughout the world. This is partly by reason of the fact that it is a completely new aircraft and not a development of a civil type. By employing greater wing area, more power and large, highly effective flaps, in conjunction with drooping ailerons, it is able to undertake many other tasks than its primary A.O.P. role. It can, for instance, be used for casualty evacuation, light liaison, supply and mail dropping, cable-laying, photography, and light freighting. On the insistence of the British Army the fuselage is a welded-steel structure, fabric-covered, and generously provided with access panels. A unique feature is the rear cockpit-floor, designed to allow a complete and rapid change of role. Upon the removal of six bolts the floor may be lowered out of the aircraft and a new floor, complete with equipment for another duty, can be quickly substituted in a few minutes. Normally only a pilot and observer are carried, but provision is made for a third seat beside the pilot, whose position has detachable armour. Entry, even in arctic clothing, is simple by virtue of three wide doors. Cabin temperature can be controlled, there is adequate windscreen demisting, and cool air is circulated from scoops positioned around the cabin to avoid draughts. Some indication of the excellent field of view is the extent—53 sq ft—of Perspex on all sides. Apart from plastic tips and a fabric covering aft of the main spar, the wings are all-metal and are built round a stiff leading-edge torsion-box. Operation of the split flaps is rendered effortless by an hydraulic assister; retraction rate is regulated and no "sink" results. Extra lift for short take-offs and landings and high drag for slow, steep approaches is conferred by the drooping ailerons.

Aiglet Trainer More than fourteen nations are using the Aiglet Trainer (Gipsy Major 10 engine) for various civil and military duties. Normally a side-by-side two-seater, it can have a third seat at the rear. Handling, as frequently demonstrated in public, is excellent, and special attention has been paid to the feel of the ailerons, these being of a new aerodynamically balanced type, specially geared. They are claimed, moreover, to reproduce the handling characteristics of larger and more powerful types of aircraft. Combined with the relatively short span (4ft less than on previous Austers) they confer a rapid rate of roll. The fuselage is of welded steel tube construction, and the wing has two wooden spars and light-alloy and steel ribs. In addition to dual controls there are two sets of wheel brakes. The pupil's set may be covered by a metal guard to prevent accidental application on touchdown. When required, a Plessey VHF radio can be installed.

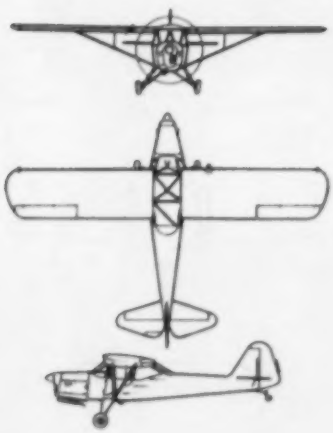


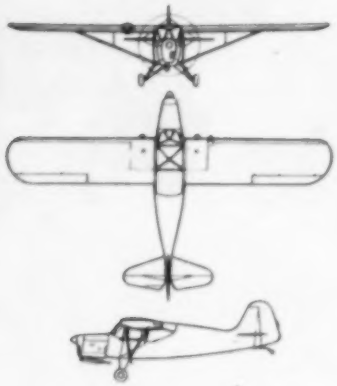
Power Plant	Blackburn Bombardier 203
Span	36ft 5in
Length	23ft 8½in
Gross weight	2,125 lb
Max. Speed	127 m.p.h.

Above and right, A.O.P.9

Below and lower right, Aiglet Trainer

Power Plant	D.H. Gipsy Major 10
Span	32ft
Length	23ft 2½in
Gross weight	1,950 lb
Max. Speed	127 m.p.h.





Autocar

Power Plant	D.H. Gipsy Major
Span	36ft
Length	23ft 2in
Gross weight	2,400 lb
Max. Speed	117 m.p.h.

Autocar The Auster company describes the Autocar as its most versatile aeroplane. This is because it can be used for crop-dusting, spraying, ambulance duties, light freighting, glider-towing, pilot training and communications; moreover, as the photograph shows, the type can be supplied as a floatplane (or, for that matter, on skis). A four-seater, the Autocar normally has the D.H. Gipsy Major 1 engine, with an overhaul life of 1,500 hr. Dual controls are fitted and for charter work the machine will carry three paying passengers anywhere within 500 miles without refuelling. By removing the passenger seats the machine is converted into a light freighter, with space available for a 570 lb load. A detachable canopy permits freighter loading from a derrick or similar device. Optional equipment includes cross-wind landing gear, stretcher equipment, radio, freight lashing fittings, and an extra-long-range fuel tank. A complete Autocar fuselage is being exhibited on the Auster stand at the S.B.A.C. Display.

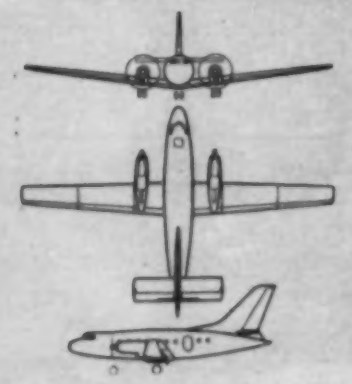
AVIATION TRADERS (ENGINEERING) LTD.

15, Great Cumberland Place, London, W.1. Telephone: Ambassador 2091

Accountant Three prototypes of this Dart-powered "Dakota replacement" are under construction and the first should fly in the spring of next year. Our general-arrangement drawing shows the latest configuration and in particular the new wing. The Heal method of construction, used in many of the components, is said not only to afford structural benefits but to cut manufacturing costs, while the Rolls-Royce Dart 510 engines should enable the machine to meet current B.C.A.R.s over a wide range of temperatures and altitudes without sacrifice of take-off weight, yet retaining short take-off and landing runs. Provision is made for water-methanol, though this would only be required under exceptional conditions. A hinged nose is available for freighting, and an unusually wide choice of payload/stage-length ratios is made possible by the large fuel capacity within the wings. The Accountant is a 12/36-seater, carrying two pilots, with a station for a separate radio operator and navigator. There is provision for a galley and one or two toilets. Maximum pressure differential is 5½ lb/sq in for cruising at 25,000ft but special flights without passengers could be made at 30,000ft at the same differential. Though mean cruising speed is quoted as high as 280 m.p.h. (about 120 m.p.h. faster than the DC-3's) the full-flap stalling speed is given as only 77 m.p.h. The Accountant promises to have a better take-off performance—particularly in the engine-cut case—than the DC-3, and apart from its greatly superior speed, will afford a higher order of comfort and at least equal stage-length flexibility. Estimated price is £110,000, plus £8,000 for radio.

Accountant

Power Plant	Two Rolls-Royce Dart 510
Span	82ft 6in
Length	60ft 6in
Gross weight	28,000 lb
Max. cruising speed	285 m.p.h. at 20,000ft



SKEETER Mk.6

for service with the ROYAL AIR FORCE

The Skeeter Mk. 6 is a product of the Saunders-Roe Helicopter Division and is powered by a de Havilland Gipsy Major 200 engine.

HELICOPTERS BY **SAUNDERS-ROE**

HELICOPTER DIVISION · EASTLEIGH · SOUTHAMPTON
HEAD OFFICE: OSBORNE · EAST COWES · ISLE OF WIGHT

THORN PLASTECK PANEL LIGHTING SYSTEM

and other important developments in console panel illumination, navigational lighting and electrical equipment described and illustrated in the new

THORN ELECTRICAL AIRCRAFT EQUIPMENT CATALOGUE

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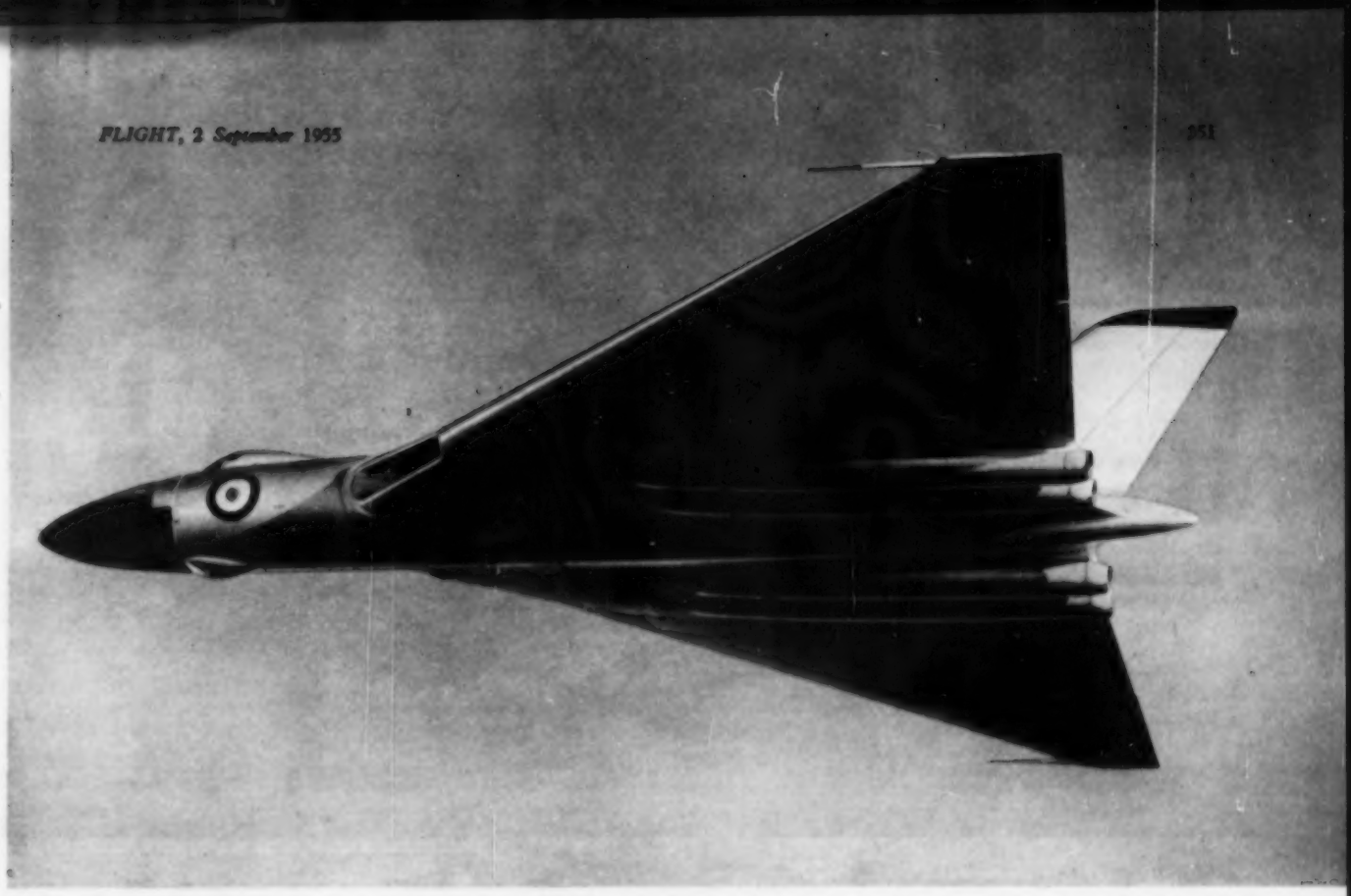

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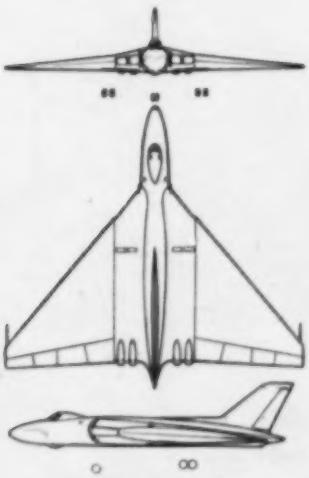
Vulcan

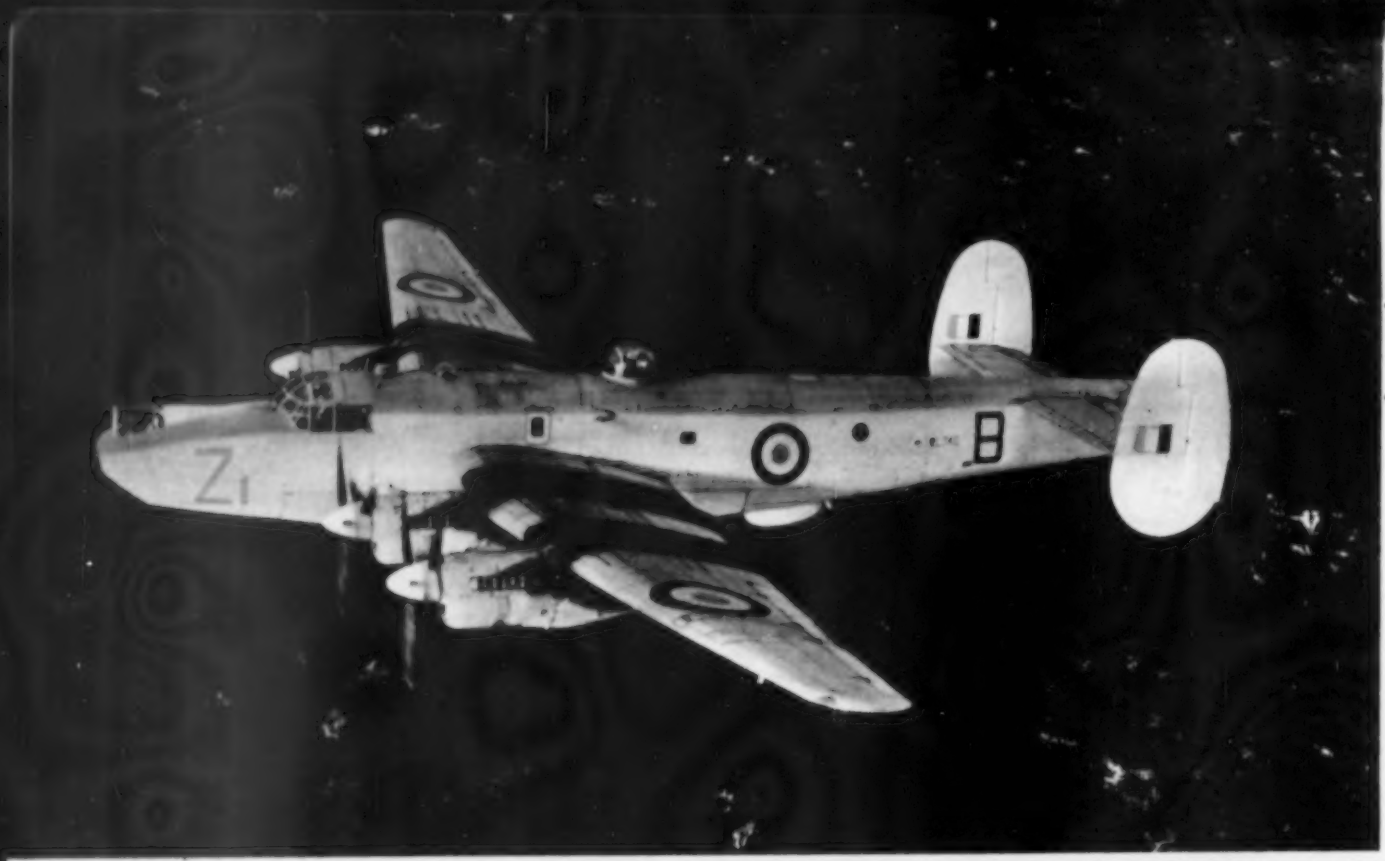
Power Plant				Four Bristol Olympus
Span	...	...	...	99ft
Length	...	...	...	97ft 1in



Vulcan As now in production for Royal Air Force Bomber Command the Vulcan B.1 four-jet delta-wing bomber is powered with Bristol Olympus 101 two-spool turbojets of 11,000 lb thrust. Performance, in terms of speed, range, altitude and manœuvrability, is of an exceptional order, yet promise of considerable development remains. When the former Minister of Supply flew in a Vulcan at a height of over 50,000ft last year, he remarked that the two prototypes had not then been "pushed", and that there was little doubt that the Vulcan still had "quite a lot up its sleeve." Essential features of the design are the delta wing, with its relatively low thickness/chord ratio yet high internal volume; the abolition of the horizontal tail surfaces; the large power-operated ailerons and elevators on the trailing edges; and the absence of flaps. The air brakes consist of rectangular panels, disposed in pairs above and below the wings. Each panel is carried on two arms and during retraction turns through 90 deg to lie flush within the wing structure. Additional braking effect is afforded by the rear doors for the main undercarriage and by the massive Dowty four-wheel-bogie assemblies themselves. There is, too, a tail braking-parachute housed asymmetrically in the starboard side of the tail cone. The first prototype Vulcan (VX770) was powered by Rolls-Royce Avons and first flew on August 30th, 1952; subsequently this same machine was re-engined with Armstrong Siddeley Sapphires. The second prototype (VX777) was powered from the outset by Bristol Olympus and first flew on September 3rd, 1953. Both machines are familiar to Farnborough-goers, but little seen in public is the first production machine (XA889). This may be distinguished by its silver finish, whereas the earlier Vulcans were glossy white, and by the dark dielectric panelling round the lower part of the nose.

All performance particulars of the Vulcan are restricted, but a proposed civil version, the Atlantic, was estimated to be able to fly non-stop from London to New York in 5-6 hr, and to cruise at over 600 m.p.h. at 40,000ft.

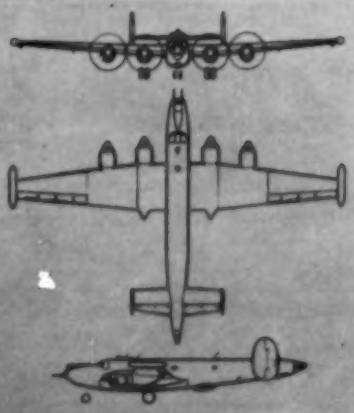
Research Deltas A unique stable of small research aircraft was built by the Avro company to determine the characteristics of the delta wing, and three variants, the 707A, B and C, are still rendering valuable service. The original Avro 707, powered by a Rolls-Royce Derwent, made its first flight as long ago as September 4th, 1949. This particular machine was later destroyed. The second to materialize was the 707B, built for low-speed research; this was first flown in September 1950. The third was the high-speed 707A, of July 1951. In February 1953, a second, similar, 707A was flown. The 707C is a side-by-side two-seater having dual control, and this has been flying since July 1953. Flying controls are in the form of separate ailerons and elevators, whereas on other deltas these are generally of the combined "elevon" type. Span of the 707C is 34.2ft and length 42.75ft.



Shackleton M.R.2

Shackleton There are three versions of the Shackleton, designated M.R.1, 2 and 3. The symbols "M.R." signify maritime reconnaissance, for the Shackleton is essentially a long-range, over-water machine, equipped to locate and attack surface and (more particularly) submarine targets. The M.R.1 was first flown in March 1949 and many of these machines continue in service with R.A.F. Coastal Command. The mark is recognized by its short nose, with "beard" radar installation, and by a blunted tail section, without armament. Two 20 mm guns are housed in a Bristol turret in the midships dorsal position. As in subsequent versions, the engines are four Rolls-Royce Griffon 67s, driving de Havilland six-blade contra-rotating, constant-speed, fully feathering airscrews. The M.R.2 version has a new, lengthened nose, with two additional 20 mm guns, aimed by a gunner who sits above the bomb-aimer. The beard-type radome of the Mk 1 is replaced by a retractable installation aft of the bomb bay and the extreme tail portion of the fuselage is tapered off into a transparent cone to provide an additional look-out position. Instead of the single fixed tailwheel of the Mk 1 there are twin retractable wheels. Essentially similar to the M.R.2, the M.R.3 incorporates a nosewheel undercarriage and has increased fuel capacity by virtue of auxiliary tanks at the wing-tips. The pilots' canopy is of the clear-view type and various changes have been made in internal equipment. As our drawing (based on the latest information) shows, the dorsal turret has been deleted from the M.R.3 though the forward guns are retained.

The M.R.3 is in production not only for the R.A.F. but for the South African Air Force, an order having been placed after the Shackleton-equipped No. 42 Squadron of R.A.F. Coastal Command had flown from Ceylon to the Union during a 17,000-mile round trip from St. Eval, Cornwall. All versions of the Shackleton carry a very formidable load of bombs, depth charges, sonobuoys or other stores, and alternative provision is made for an air/sea-rescue lifeboat. A crew of ten is normal, comprising captain, co-pilot, two navigators, engineer and five signallers. Maximum take-off weight of the M.R.2 is 86,000 lb. When a member of *Flight*'s staff visited a Shackleton squadron in Malta last year he wrote: "In addition to operational requirements there is a search and rescue commitment which entails one Shackleton and crew being at immediate readiness 24 hours a day for 365 days of the year. With Malta as the centre, these aircraft operate westward to Gibraltar, southward into North Africa and eastward to the Aegean Sea. The service is available to all ships, to all aircraft, R.A.F., naval and civil, and to anyone travelling in the North African deserts . . . On the occasion of the Queen's return last summer from her Commonwealth tour two Shackletons escorted Her Majesty from Aden to Entebbe. On the return flight one Shackleton, with long-range tanks, made the journey from Entebbe to Luqa in one hop . . ." In this country the Coastal Command Shackletons have made a name for themselves by the very high standard of their formation flying, notably in the Royal Review fly-past at Odiham and at the recent R.A.E. Golden Jubilee celebrations. The precision of this flying bespeaks good control—an important characteristic in an anti-submarine aircraft, which must take immediate and spirited evasive action after its low-level attacks. Previous S.B.A.C. Displays have borne further testimony to the Shackleton's handling qualities, and it may be noted that in the drawing of the M.R.3 herewith the ailerons have been revised, possibly indicating further improvement.



Shackleton M.R.3

Power plant	Four Rolls-Royce Griffon
Span	120ft 6in
Length	87ft 4in

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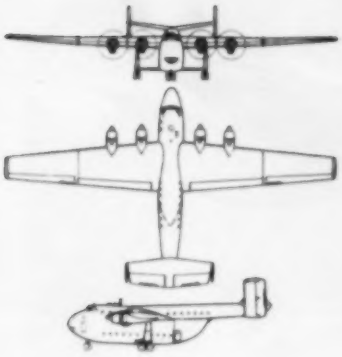

Beverley C.1

Power plant	**Four Bristol Centaurus 173**
Span	162ft
Length	99ft 2in
Gross weight	135,000 lb
Max. speed	238 m.p.h. at 5,700ft

Beverley and Universal Whereas the Beverley C.1 trooper/freighter is already far advanced in production for R.A.F. Transport Command, the Universal, its civil counterpart, is still in the project stage, though, as Blackburn's chairman recently pointed out, delivery dates which can now be quoted are "not so distant," and the signs in some quarters "not unhopeful." He remarked on the same occasion that the Beverley is, in overall size, the largest aircraft being manufactured in the British Commonwealth. Notwithstanding the great bulk of the aircraft, however, the company were successful in meeting the target flight-date of the first production machine which had been set by the Ministry of Supply some 2¼ years earlier. Subsequent Beverleys have left the assembly line as programmed, and although a good deal remains to be done to bring the aircraft to full operational standard, the first R.A.F. squadron should be formed by the end of the year. The production Beverley differs in certain respects from the prototypes; the only visible innovation, however, is the fitting of "bell-bottomed" fairings to the main undercarriage legs. For R.A.F. Beverleys alternative types of wheel will be available: machines operated from runways will have a tyre pressure of 80 lb/sq in, and for those using grass fields the pressure will be 50 lb/sq in (using the same axle and Maxaret brake unit). Fuselage modification now provides a virtually unobstructed cross-section of 10ft × 10ft throughout the 40ft length of the hold, and about 200 lb has been saved by employing a new form of construction for the transverse frames supporting the floor. Although a layout exists for a 162-seater Beverley, the standard R.A.F. troop-carrier version will probably be a 94-seater. All passenger seats face aft. As a paratrooper the Beverley carries 70 soldiers, as an ambulance 82 casualties, or as a freighter 45,000 lb—all over a distance of 200 nautical miles. Take-off run at full load is 790 yd, and landing run, under the same condition, 310 yd. Provision is made for rocket-assisted take-off. An Air Ministry statement concerning the Beverley runs: "The tasks performed by this aircraft will include the moving by air of complete units of any service, with equipment: the support of ground forces in the field: casualty evacuation: supply dropping and parachute exercises of up to battalion strength. When the squadron is functioning it will carry out a training programme incorporating all these operations. As has always been the case with R.A.F. Transport Command aircraft the Beverley force will be available for carrying men and supplies of the three armed services and will also be at the disposal of other Government departments."

When a member of *Flight's* staff visited Brough earlier this year he wrote: "Both the main hold and the tail boom (which is itself of greater capacity than a Dakota fuselage) will be fully soundproofed. The trimming scheme proposed for the upper deck may be inspected in mock-up form at Brough; it involves blue walls, a white ceiling and white Fibreglass window frames. Mounted in the lower-deck nose-section of the Beverley, a 14 h.p. auxiliary powerplant driving a 6 kW generator will provide current for starting, battery charging, loading and cabin heating at forward strips possessing no ground power-sources. This unit, of A.B.C. design and manufacture, will have a four-cylinder petrol engine . . . The Fibreglass spinners and cooling fans supplied with the D.H. hollow-steel airscrews afford a saving of 140 lb, and at Brough a special shop has been set up to make Fibreglass components."

BOULTON PAUL AIRCRAFT, LTD.

Wolverhampton, Staffs.
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Balliol and Sea Balliol The Balliol T.2 advanced trainer, with Rolls-Royce Merlin 35 engine, is in service with the R.A.F. and the Royal Ceylon Air Force. Its naval counterpart, the Sea Balliol (described below) is operating with the Royal Navy. The specification called for a monoplane of robust all-metal construction, with "modern" handling characteristics suitable for use by day and night for dual flying instruction (including aerobatics); advanced pilot-training (including long cross-country flights); dual front-gun training; dual low-level, glide and dive-bombing training; and glider-towing. In conformity with R.A.F. policy, the instructor and pupil are seated side by side and their wide canopy is placed well forward. All main controls are fully duplicated, as are the gun-sights, and the flying instruments and gauges are placed within easy view from both seats. The inner wings are attached on the fuselage by four pin bolts and the outer wings are similarly attached, but with latch gear to withdraw the lower pair, permitting upward folding. There are two spars, the portion between them forming a rigid torsion box continuous over the span. Ailerons are interchangeable from port to starboard, and there are dive brakes which limit the terminal velocity to 350 m.p.h. The fuselage is a circular-section light-alloy monocoque. For armament training a 0.303in Browning gun can be fitted in the port wing, and provision is made for eight practice bombs or four rocket projectiles. The deck-landing version of the Balliol has an undercarriage capable of absorbing a vertical velocity of 14 ft/sec. The main units have a longer stroke and greater displacement than those of the Balliol, and the tail undercarriage unit incorporates a double-extension oleo-pneumatic shock-absorber, a separate self-centring unit, a shimmy damper, and a steering mechanism controlled from the cockpit. The hydraulically damped arrester hook is controlled by the pilot, and there is a cable-deflector assembly to prevent the arresting cables from fouling the tailwheel. To avoid any disturbance of the centre of gravity by the addition of the naval equipment the accumulators have been moved forward to positions in the inner wings.

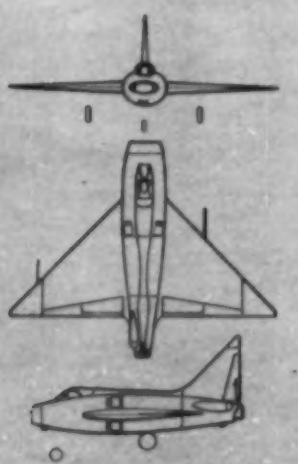
P.111A Previously illustrated with blunted wing-tips, this delta-wing research aircraft is depicted on this page with alternative—almost pointed—tips. The picture was taken on the occasion of the recent Golden Jubilee celebrations at the Royal Aircraft Establishment, where the machine is giving excellent service as a research vehicle. The power unit is a Rolls-Royce Nene. A parachute is housed in a fairing on the port side of the fuselage to reduce landing speed and rolling distance. The dive brakes are of unique form, being in four rectangular sections, two on each side of the fuselage, one above and one below the wing. Viewed head-on, with brakes out, the P.111A appears to wear a ruff.

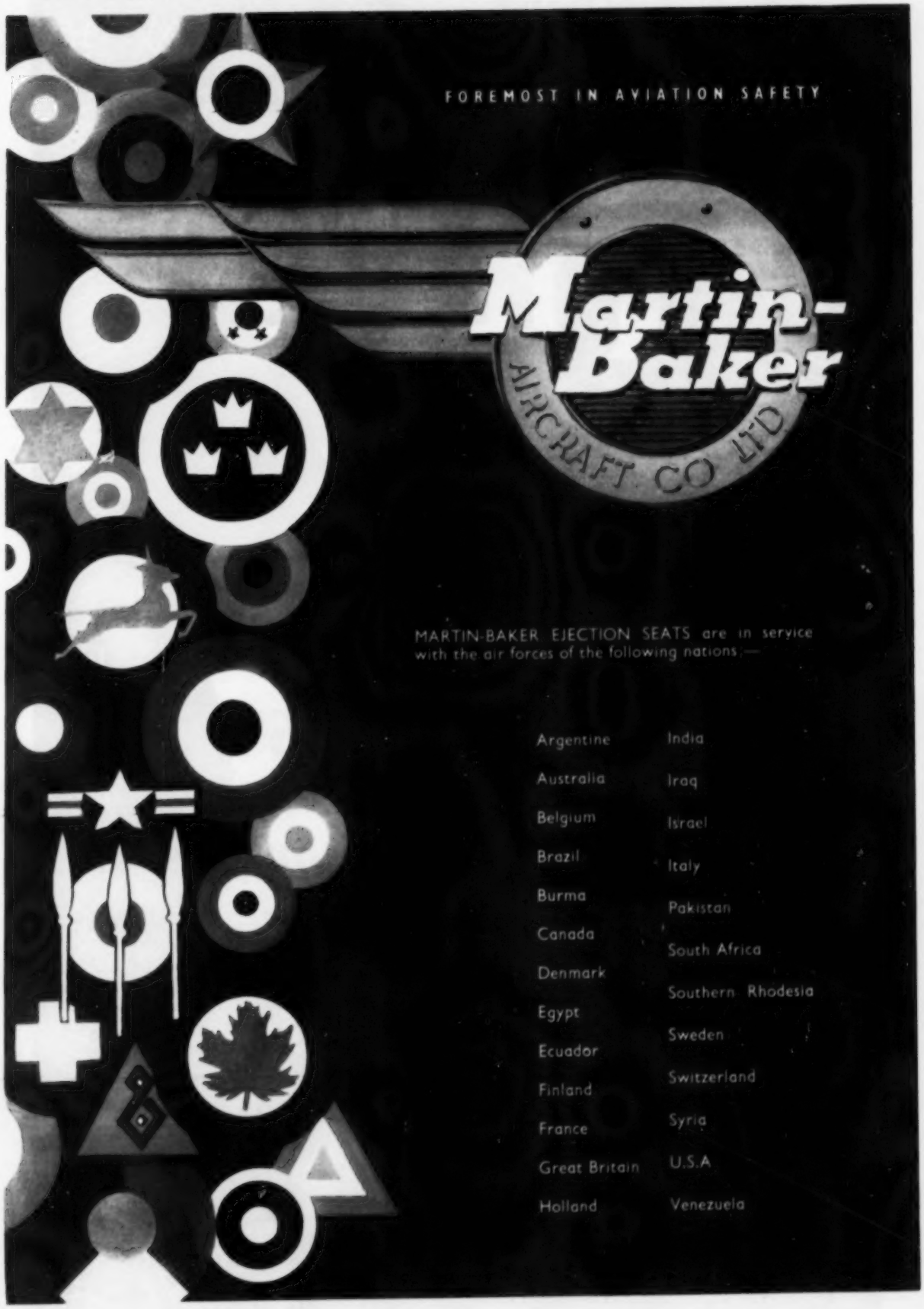
Power plant ...	Rolls-Royce Merlin 35
Span	39ft 4in
Length	35ft 11in
Gross weight	8,704 lb
Max. speed	285 m.p.h.

Above, Sea Balliol

Below, P.111A

Power plant ...	Rolls-Royce Nene
Span	33ft 6in
Length	26ft 1in

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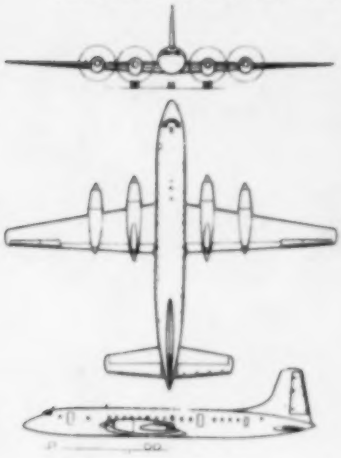


Britannia 300LR

Power plant	**Four Bristol Proteus 755**
Span	142ft 3½in
Length	124ft 3in
Gross weight	170,000 lb
Cruising speed (long range)	357 m.p.h

Upper photograph shows Type 170, Mk 32; below is the Britannia 100

THE BRISTOL AEROPLANE CO., LTD.

Filton House, Filton, Bristol
Telephone: Filton 3831

Britannia The first production version of this, the supreme airliner of its class, is the Britannia 100. Fifteen of this model, with Proteus 705 engines, each of 3,780 e.h.p., are on order for B.O.A.C., and after these machines are completed all subsequent Britannias will be powered with the Proteus 755, of 4,120 e.h.p. Also earmarked for B.O.A.C. are eight Britannia 300s (this model has a fuselage 10ft 3in longer and has a greater payload) and ten Britannia 300LRs (the 300 with additional tankage). Three Britannia 300LRs will go to El Al Israel Airlines, who have an option on a further two, and for trooping work the British Government is ordering three Britannia 250LRs, which are mixed passenger/cargo aircraft. In operational flexibility the Britannia is probably unequalled, and the makers consider its economical range to be 600-6,000 statute miles. According to arrangement, it can seat from 60 to 101 passengers; or it can be used as a freighter or with passengers and freight in combination. It can fly economically at any height between 20,000 and 30,000ft, and the 300LR model is capable of maintaining regular non-stop services across the North Atlantic the year round. Further indicative of versatility is the maritime-reconnaissance version, the prototype of which is now well advanced in construction at the Montreal plant of Canadair, Ltd. This machine,

designated CL-28, is, however, 60 per cent redesigned, and the selected engines are Wright Turbo-Compounds, which will afford a 24-hour endurance. The crew will number 15, and in addition to a variety of anti-submarine weapons, 21 different radio and radar installations are planned. A major increment in Britannia performance will result from the eventual installation of Bristol B.E.25 turboprops, providing 75 per cent more cruising power than does the Proteus. It has been announced that B.O.A.C. are to purchase 60 of the new engines for retrospective installation in a number of their Britannias.

Structural efficiency of the Britannia is of an exceptional order. The basic material is high-strength light-alloy. Major joints are riveted and all external riveting is of the close-tolerance flush variety, employing spin dimpling. Additionally the Redux method of metal bonding is widely employed in all double-skin components such as pressure bulkheads, leading edges with a corrugated inner skin for de-icing air, box ribs and local skin-reinforcement. The wing has a taper-box spar bounded by webs at 15 and 50 per cent chord, the latter taking shear loads only. All end loads due to bending are accommodated by upper and lower skins and by spanwise stringers. In consequence the wing has excellent resistance to fatigue and provides the maximum possible space for fuel in the tip-to-tip inter-spar box. Fatigue life has been further improved by adding Redux-bonded reinforcement strips over all bolted or riveted

Above, Type 173

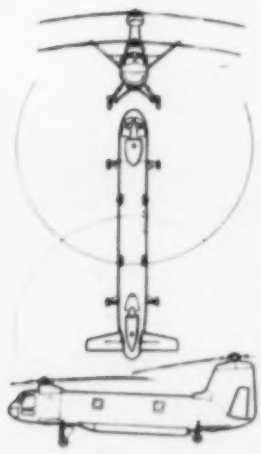
Below, model of Type 191

Power plant	**Alvis Leonides Mk 73**
Rotor diam.	48ft 6.7in
Fuselage length	42ft
Gross weight	5,400 lb
Max. speed	127 m.p.h.

Above, Type 171

Below, Type 191

Power plant **Two Alvis Leonides Major**



skin joints on the under surface. The LR Britannia has a rather heavier wing structure by reason of its greater weight and higher speed. The Britannia fuselage maintains a constant circular section with a diameter of 12ft, giving an optimum floor height only 18in below the horizontal diameter and permitting six-abreast passenger seating with 80in of gangway headroom and an underfloor hold 40in deep.

Type 170 Of over 200 Type 170 Freighters delivered to date, some 90 per cent have gone to operators overseas. The type is serving not only with civil companies but with the air forces of Australia, Canada, New Zealand, Pakistan, Burma and Iraq. On the Mk 31, which is the pure freighter version, nose doors give access to a cargo hold of 2,020 cu ft capacity, behind which is a lobby space of 340 cu ft. Height is such that a possible load is a three-ton lorry. The Mk 31E Wayfarer is a mixed-traffic machine, with soundproofing, heating and ventilation, and the Mk 31M is a military version. To the order of Silver City Airways the company developed the Mk 32, the fuselage of which is lengthened forward of the wings. The Superfreighter, as this machine is sometimes called, takes various combinations of vehicles and passengers. There is a structural bulkhead which, in its rear position, gives a hold length of 42ft 3in, accommodating three cars, each 14ft long, or two of the largest American cars. Additionally there are seats for up to twelve passengers.

Type 171 Over 70 Type 171 Sycamores have been delivered, and substantial orders remain to be filled for the British Services. Numerous variants have been developed, including the Mk 3A, for B.E.A. passenger work; the Mk 4, the basic production version for casualty evacuation, search and rescue, and passenger and freight transport; the H.C.10 ambulance with Perspex blisters; the H.C.11, a British Army model for communications, transport and observation; the H.R.12 for search and rescue duties with R.A.F. Coastal Command; the H.R.13, for similar duties with Fighter Command; the H.R.14, for ambulance, communications or search and rescue work with the R.A.F.; and the H.R.50, for communications and search and rescue with the Royal Australian Navy. The power plant is invariably an Alvis Leonides, mounted with its crankshaft vertical and driving a three-blade main rotor of wooden construction. The Sycamore has been intensively tested in widely differing climates, and has been subjected to a period under operational conditions in the Malayan jungle. Operating as an air ambulance in Kenya one of these machines has taken off, while evacuating casualties, at a height of 10,000ft. A 4/5-seater, the Sycamore is unusually vibration-free.

Type 173 The Type 173 helicopter is the first twin-engined machine of its class capable of safe flight with one engine shut down. This is made possible by interconnection of the individual rotor gear-boxes by a synchronizing shaft running along the top of the fuselage and keeping both rotors in phase, and—in the event of an engine failure—allowing one engine to drive both rotors. The 173 itself is a development aircraft and has not been put into production. The first prototype flew in January 1952 and the second in the summer of 1953, and extensive flying experience has been gained. A recent development is the fitting of four-blade rotors. On the occasion of the Paris International Aeronautical Salon in June this year a Type 173 flew from London's South Bank to Le Bourget in two hours, the average speed being 112 m.p.h. Flight trials have been conducted with and without wings.

Type 191 It was announced earlier this year that an order had been placed with the Bristol company for about a hundred twin-engined helicopters for the British Armed Services. These will include a substantial number of Type 191s, specifically designed for anti-submarine work. They will carry not only search equipment but strike weapons, and will be suitable also for air/sea-rescue and transport duties. Whereas the prototypes will have Alvis Leonides engines, the initial production versions will be fitted with Alvis Leonides Majors and ultimate production versions will have gas turbine power.

THE DE HAVILLAND AIRCRAFT CO., LTD.

Hatfield, Herts.
Telephone: Hatfield 2345

Comet The Comet 3 to be demonstrated at Farnborough is regarded as the development prototype of the new Comet 4. It is at present undergoing an intensive flight-testing programme to ensure that a considerable part of the corresponding programme for the Comet 4 will be completed before that aircraft actually takes the air. The Comet 3 already has behind it some 150 hr of flying, in the course of which the performance has been measured, and from this the basic capabilities of the Series 4 have been estimated. The makers state that with due allowance for take-off, climb, diversion, stand-off, descent, etc., the stage length of the new aircraft is expected to be more than 2,900 statute miles, carrying the volumetric first-class payload of 16,400 lb. Corresponding figures for the tourist version are 2,700 statute miles and 19,300 lb. This capability, it is claimed, establishes the Comet 4 as a machine capable of operating non-stop the majority of the world's busiest trunk routes.

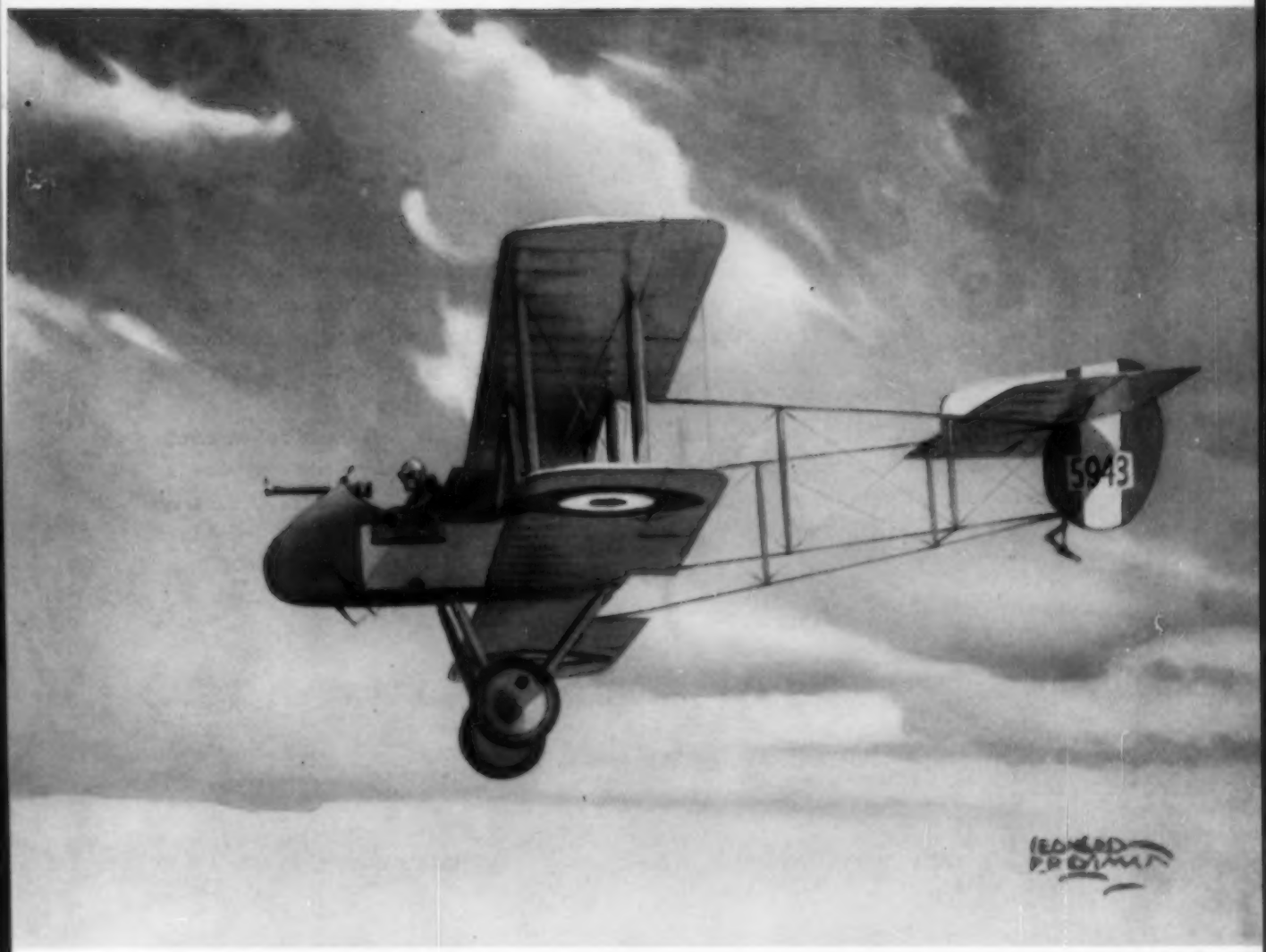
As outlined in a statement earlier this year, the Comet programme entails the building of twenty machines for B.O.A.C. These will be powered by Rolls-Royce Avon R.A.29 engines, of 10,500 lb static thrust, whereas the Mk 3 has Avon RA.26s, of 10,000 lb thrust. All-up weight will be 152,500 lb against 150,000 lb, and fuel capacity 8,760 Imperial gallons—an increase of 400 gallons over the Comet 3. Cruising altitude will be the same for both versions, namely, 42,000-45,000ft, but cabin pressure differential for the Comet 4 will be slightly higher at 8.75 lb/sq in. With their Comet fleet B.O.A.C. will be able to fly to Johannesburg with stops at Cairo and Nairobi. There will be direct services from London eastwards to Beirut, thence to Karachi, Bangkok, Okinawa and Tokyo. A de Havilland announcement runs, "On the North Atlantic route the Comet 4 will carry its full capacity payload from London to Gander, Newfoundland, with full reserves, thus making its application to the London-New York service an economic possibility." Structurally the aircraft will incorporate all developments accumulated since the first flight of the Comet 1 in 1949, including those resulting from experience gained in some 30,000 hr of airline operation. Superimposed on this experience was the investigation of 1954—an undertaking, the makers point out, without precedent in aeronautical engineering. Advantage is being taken of advances in the knowledge of metal fatigue, and it was announced in May that in the preceding months a great deal of repeated-load testing had been undertaken on full-scale components. Especially, the stress level in the fuselage seam joints and cut-outs has been kept low, so that local damage should not affect the safety of the structure.

Concerning the performance of the Comet 4, the makers state: "The take-off performance is such that only very rarely will this be a limiting factor. The take-off performance has been evaluated on the assumption that an engine fails at the critical point, and the aerodrome length required is defined as the distance to reach a height of 50ft on three engines or the total accelerate-stop distance. Because of the increase in thrust of the Comet and in spite of the greater all-up weight, the take-off performance of the Comet 4 will be somewhat better than that of the Comet 3. As a general rule it may be said that the take-off weight of the new Comet may be increased by about 3,500 lb above that of the Comet 3 for a given aerodrome length. The optimum cruising speed of the Comet 4 corresponds to a Mach number of 0.74, which is equivalent to 489 m.p.h. in standard atmosphere rising to 506 m.p.h. in an atmosphere 15 deg C hotter than standard."

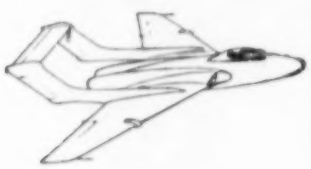
Data for Comet 4 (Illustrations show Comet 3)

Power plant ...	Four Rolls - Royce Avon RA.29
Span	115ft
Length	... 111ft 6in
Gross weight ...	... 152,500 lb
Cruising speed ...	489/506 m.p.h.

AS IT WAS . . .



THE D.H.2 of 1915—the Royal Flying Corps' first armed single-seat fighter—was a pusher with tailbooms. Today, forty years later, the D.H.110, now in production for the Royal Navy, is also a pusher with tailbooms, but with a difference! Powered by a 100 h.p. Gnôme Monosoupape rotary engine, the D.H.2 had a top speed of 82 m.p.h. which, with its single forward-firing Lewis gun, enabled it to defeat the early "Fokker menace" of World War I. The D.H.110 day and night fighter, powered by two Rolls-Royce Avon turbojet engines, is transonic and tropospheric and is equipped with the most advanced armament and electronic combat and navigational equipment. Comparable progress in D.H. civil aircraft can be traced from the D.H.18 of 1920—de Havilland's first original airliner—to the Comet 4 jet airliner of today.



Still the pace quickens, and every new project brings fresh problems. Questions about fuels and lubricants to meet these increasingly exacting conditions are the constant concern of ESSO research groups whose information and advice are freely at the disposal of enquirers with problems in this field.

It pays to consult

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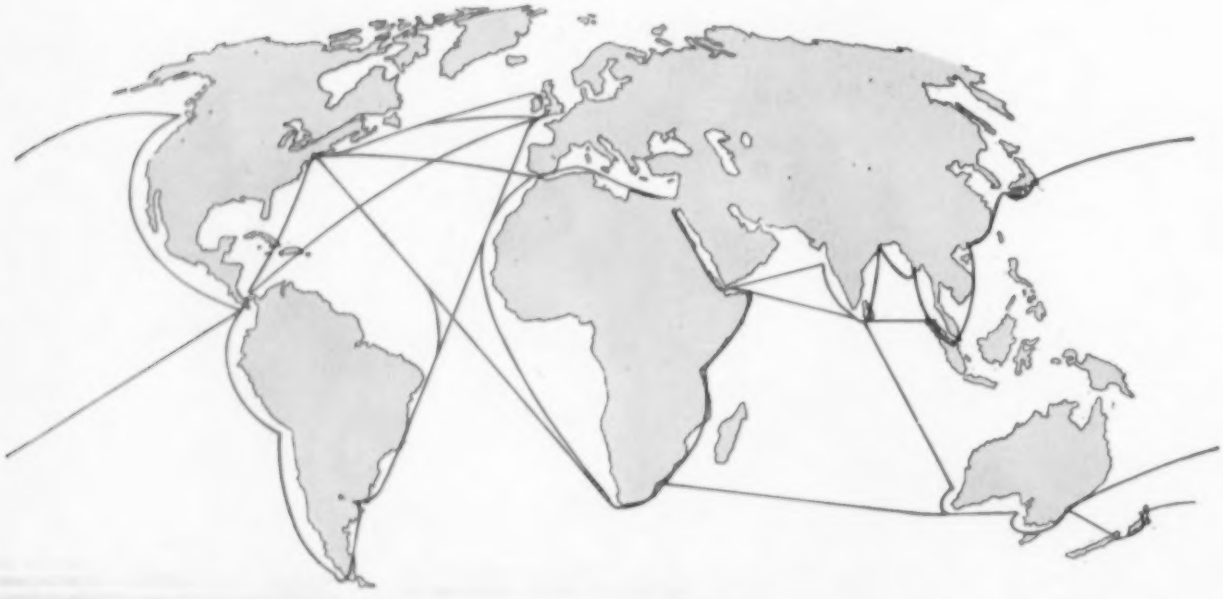
ESSO PETROLEUM COMPANY LIMITED, 36 QUEEN ANNE'S GATE, LONDON, S.W.1. *AVIATION TECHNICAL SERVICE, RELIANCE 1261*

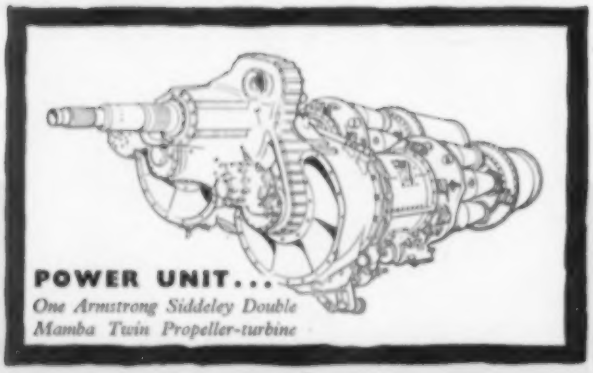
FAIREY... five

FIRST, the indispensable weapon, the submarine hunter. The importance of keeping open the sea-lanes that support a Western nation at war need no emphasis; we have learned the hard way. Now, with Gannet squadrons in service at sea and ashore, the scales are loaded a little more on the side of the hunter. The endless anti-submarine war could be fought with much more certain ability to seek out, find and destroy the hidden enemy.

The Gannet specification covers many roles. The twin engines in a single installation are responsible in part for its great operational flexibility: single engine for prolonged search with comprehensive radar: twin engine power on demand for deck flying and to come swiftly to grips with an elusive target.

Gannet squadrons have formed and embarked in British carriers, ready to take their place in the strategic world-wide command of the seas essential to N.A.T.O. forces.





POWER UNIT...
One Armstrong Siddeley Double Mamba Twin Propeller-turbine

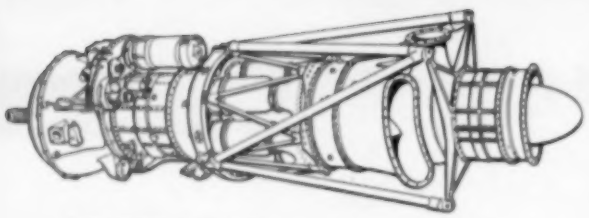
1st

aspects of air power

Fairey Gannet

FAIREY... five

HERE is the first really *economical* Helicopter for civil and military duties. The Rotodyne principle is an accepted means of combining the best features of two forms of rotary-wing flight — helicopter and Autogiro — with a most efficient system of tip propulsion. Two Napier Eland low-consumption turboprop engines provide power both for lift and forward flight, with a completely progressive changeover from one to the other The Rotodyne, currently under development to Ministry of Supply order, will pioneer new forms of load-carrying.



POWER UNIT...
Two Napier Eland Propeller-turbines

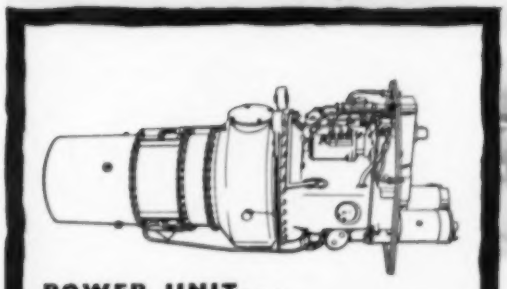
2nd Rotodyne Helicopter

aspects of air power

FAIREY

AND now, new tools for the land forces. The Fairey Ultra-light Helicopter is a communications and observation aircraft suitable for operation in any terrain: simple, transportable in a standard 3-ton truck, economical both in fuel and skilled maintenance requirements.

The Fairey Ultra-light Helicopter has a crew of two. Its primary functions include A.O.P., staff transport and communications, tactical reconnaissance and traffic control.



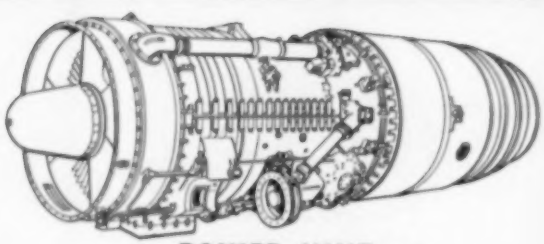
POWER UNIT...

One Blackburn-Turboméca Palouste Gas Turbine

3rd Ultra-light Helicopter

FAIREY... five

How to go faster: the basic unchanging problem of aircraft design. Mach 1 is no longer the target; but higher Mach numbers present entirely new obstacles. The Fairey Delta 2 will play a part in the investigation and solution of these problems at newly-attainable speeds, showing the way to aircraft for the future needs of N.A.T.O. and the Western world.

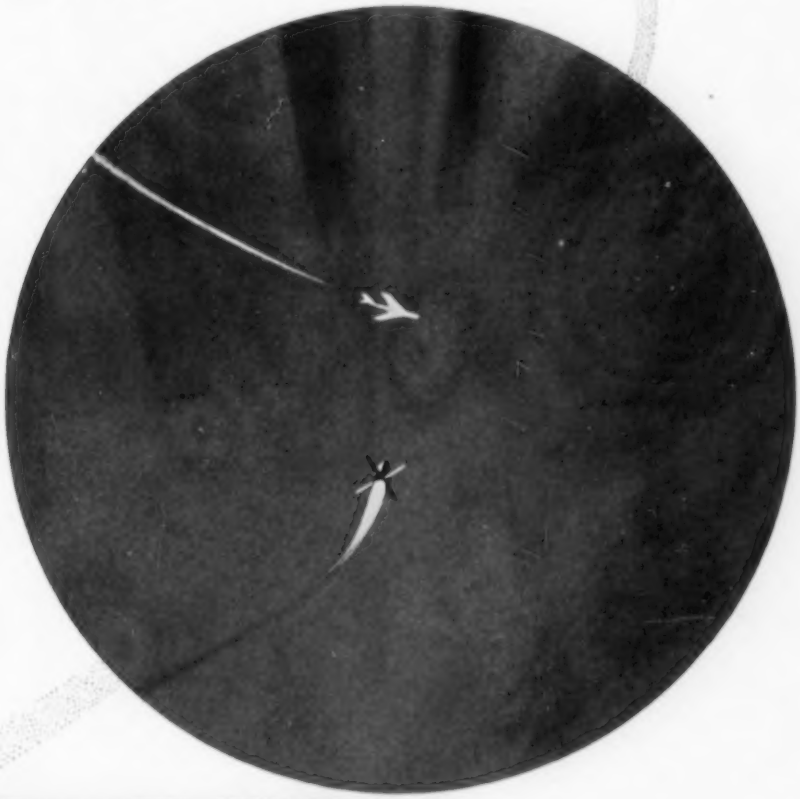


POWER UNIT...
One Rolls-Royce Avon Turbojet

4th The Fairey Delta 2

aspects of air power

AND now — pilotless flight: the guided weapon. Again Fairey pioneered a complex and difficult science, integrating new conceptions of flight, propulsion and control into a system of defence which provides a key to effective protection against the high-flying, jet-powered atom-bomber.



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5th

Fairey Guided Weapons

Decca—the navigational "life line" for

every aircraft operating over Western Europe **DECCA**

shows the way

THE DECCA NAVIGATOR CO LTD LONDON

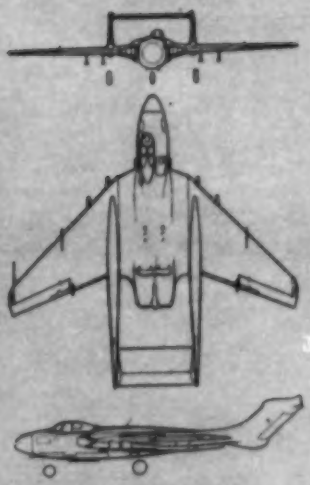
Top right, Dove
Right, Heron Series II; below, Series I. Data are for Series II

Power plant ...	Four D.H. Gipsy Queen 30 Mk 2
Span	71ft 6in
Length	48ft 6in
Gross weight	13,000 lb
Max. w.m. cruising speed	191 m.p.h.

Dove The Dove to be exhibited in the static park at Farnborough is the Series 6, which is an executive version generally similar to the Series 5. It offers accommodation for six passengers, with baggage, and a crew of two—a load it can carry over stages of up to 630 miles with a fuel reserve sufficient for an hour's stand-off. Design refinement is claimed to have made the cabin of the Dove more spacious than any other aircraft of the same size and weight. The windows are of unusual size, and the view from the cockpit is also exceptionally good. Full dual control is fitted, although the starboard column can be detached if the seat on that side is occupied by a radio operator or passenger. The Gipsy Queen 70 Mk 2 engines drive de Havilland constant-speed feathering airscrews. Behind the Dove is a comprehensive distributing and servicing organization throughout the world, including the United States of America. Some 500 Doves have been delivered, including a number of the military version, known in the British Commonwealth as the Devon.

Heron The two basic versions of the Heron four-engined light transport are the Series 1, with fixed undercarriage, and the Series 2, with retractable gear. The model being demonstrated at Farnborough is the newest variant, with de Havilland feathering airscrews. The additional safety afforded by these entails a small sacrifice in payload (about one passenger) but will, it is considered, further widen the appeal of the aircraft, about eighty of which have now been delivered to a score of countries. The airscrews are probably the smallest in the world to be fitted with a feathering device. Like its predecessor, the Dove, the Heron is an attractive executive machine. Take-off distance is 745 yd (865 yd with one engine out), and landing distance 550 yd. A special Series 2 Heron is on the strength of the Queen's Flight.

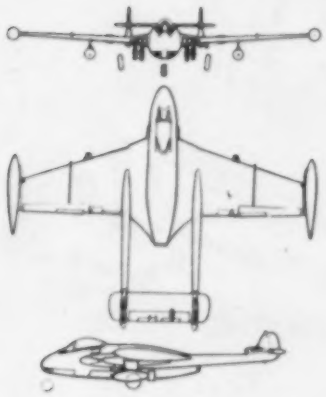
D.H.110 The makers report that trials of the two prototype D.H.110s are proceeding at a rapid pace, with the basic performance and handling characteristics of the type now fully established. Test work now in hand concerns development of the aircraft up to its full "navalized" condition, entailing the carrying of external stores and radar, and the studying of take-off and landing characteristics. The 110 has been ordered into quantity production as the standard two-seat all-weather fighter for the Fleet Air Arm. The history of the design begins with a naval conference in January 1947, as a result of which a requirement was issued in the following June for a twin-engined all-weather fighter to Specification N.40/46. In August of the same year the R.A.F. also issued a specification calling for a machine of the same general type (F.44/46), and this, after much alteration, became F.4/48 in March of 1948. Concurrently the naval specification was developed into N.14/49. By 1949 the de Havilland company had decided to build two prototypes, principally to meet F.4/48, and the first of these flew on September 26th, 1951. During 1952 this became the first British aircraft to exceed the speed of sound in a dive, and before the S.B.A.C. Display at Farnborough that year had exceeded Mach 1 over a hundred times. It will be remembered that during a demonstration of an ex-



Power plant	Two Rolls-Royce Avon
Span	51ft
Length	52ft

Above, D.H.110

Left, Venom N.F.3

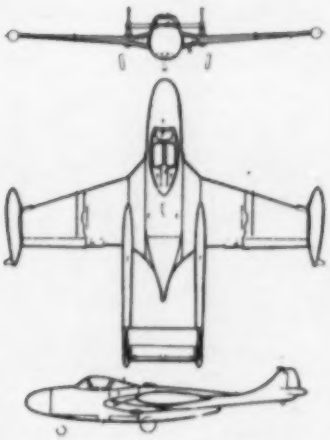


Power plant	D.H. Ghost
Span	41ft 9in
Length	33ft

Above, Venom F.B.4

Below, drawing Sea Venom N.F.21, photograph F.A.W.53

Power plant	D.H. Ghost
Span	41ft 9in
Length	35ft 3in

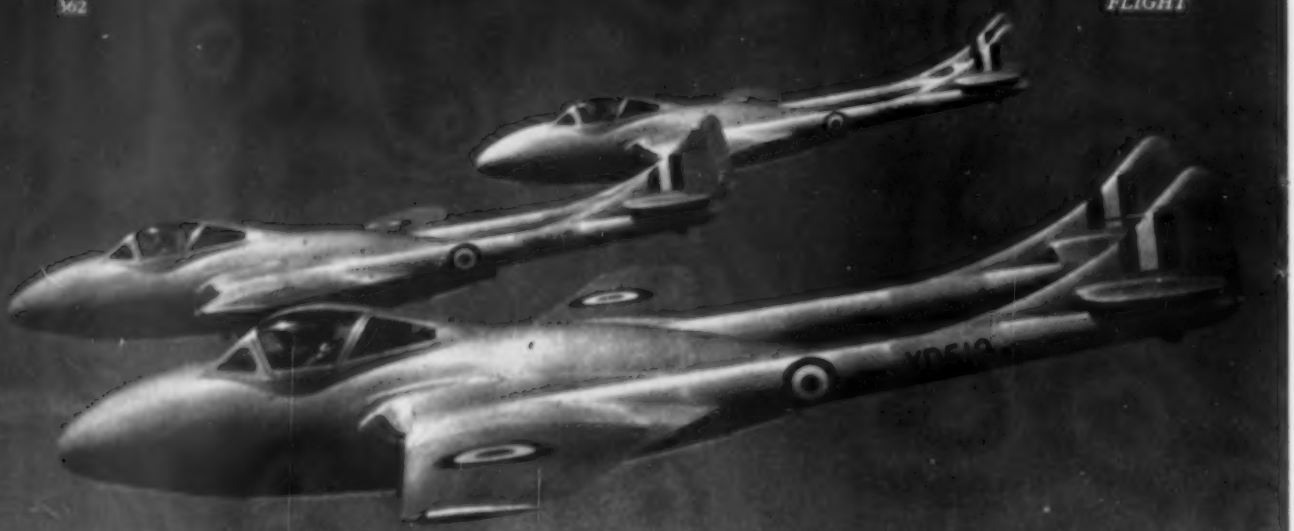


ceptionally high order the aircraft broke up with tragic results. Development, however, went ahead, although the second machine was grounded for almost nine months, during which an intense technical effort was exerted. Flying trials since that date have been most encouraging. A report in *Flight* during January this year stated: "Speeds well in excess of Mach 1 have been recorded on almost every recent flight, and rate of roll and turn are extremely high throughout the top end of the speed range. The entire flying-control system is hydraulically powered—even the rudders—and, in the air, the new all-flying tailplane behaves as a very powerful one-piece slab. It has not been found necessary to vary the tailplane gear-ratio for either end of the Mach scale. At the bottom end of the scale, the slow-speed control is first class in every respect, the drooping outer leading edge—which incurred no measurable drag penalty—being of assistance. The stall is all that a stall should be, straight and 'square' and with plenty of natural warning. Lowering the massive Fowler flaps unlocks what looks like an elevator from the slab tailplane, so that the trim change can be automatically cancelled out. The tail, nevertheless, retains great power for rounding-out, and the final touch-down is slower than that for the Sea Venom. Anti-skid braking will be a standard fitting." It was further remarked that if an engine cut above the critical speed, the 110 would climb out on one with "everything down." In fact, virtually the only effect of cutting an engine is a decrease in performance, trim change being negligible. The production 110s for the Royal Navy will be armed with 30 mm Aden guns, and have provision for air-to-air guided missiles. Alternatively a heavy load of attack weapons can be disposed under the wings.

Venom Night Fighter Essentially similar to its forerunner, the N.F.2, the Venom N.F.3 night fighter, now a standard R.A.F. machine, has been equipped with improved flying controls, a more modern radar installation, and a re-designed clear-vision cockpit canopy. The engine is one of the latest marks of de Havilland Ghost, and the armament four 20 mm guns. Altitude performance and handling is exceptional for a machine of the class. Venom night fighters have been supplied to the Royal Swedish Air Force.

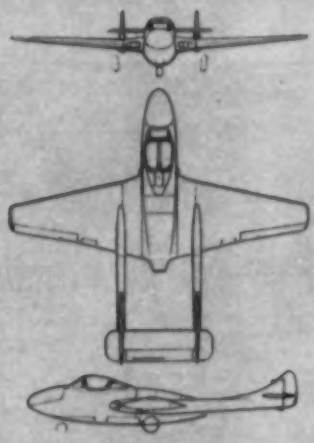
Venom Day Fighter/Bomber Numerous squadrons of the R.A.F. overseas are equipped with the Venom F.B.4, a high-performance single-seater capable of operating as a day intercepter or in the ground-attack rôle. Compared with its predecessors it has improved controls. Auxiliary fuel tanks are carried at the wing-tips, and under-wing provision is made for bombs and/or rocket projectiles. Built-in armament, as on other Venoms, is four 20 mm guns. Maximum speed is far in excess of 600 m.p.h. Venom fighter/bombers have been supplied not only to the R.A.F. but to Switzerland, Burma, Iraq and Italy.

Sea Venom The Sea Venom N.F.21 is a naval counterpart of the N.F.3 and likewise has improved manœuvrability at high Mach numbers. Features include power-folding wings, catapult gear, provision for rocket-assisted take-off, and an arrester hook, which is retracted into a fairing over the rear end of the central nacelle. Armament is four 20 mm guns, and under-wing provision is made for eight rocket projectiles. Thus, with its radar the Sea Venom is capable of making anti-shipping strikes either by day or night. As in the Venom N.F.3, the crew sit side by side, and the observer (who wears a back-type parachute) is slightly behind, and to the right of, the pilot. Both positions have provision for pressure breathing and g-suit. Sea Venoms are serving with the Fleet Air Arm and the Royal Australian Navy (F.A.W.53) and a developed version, known as the Aquilon, is built under licence in France by the Société Nationale de Constructions Aéronautiques du Sud-Est.



Vampire Trainer A measure of the Vampire Trainer's merit is the list of countries supplied: Great Britain, Australia, Burma, Chile, Egypt, Finland, India, Iraq, Lebanon, New Zealand, Norway, Portugal, South Africa, Southern Rhodesia, Switzerland and Venezuela. The machine is outstandingly tractable and versatile. In the Royal Air Force all pilots earn their wings on the type and go solo after some 6½ hours' of dual instruction. At the end of their advanced flying course they are proficient enough to convert with confidence to the newest transonic fighters. Instructor and pupil sit side by side in a pressurized cockpit with clear-view canopy. Ejection seats are fitted, and provision is made for instruction and practise in fighter navigation, combat, bombing, gunnery and rocket firing. With two 20 mm guns, 300 rounds of ammunition and full internal fuel it is possible to carry several combinations or rockets, bombs and external tanks. For rocket instruction eight 25 lb or 60 lb projectiles can be carried in addition to two 100-gal external tanks. Without the latter it is possible to carry practice bombs or two 500 lb bombs in addition to rocket projectiles. Two 1,000 lb bombs can be carried in place of the tanks, but not normally with rockets fitted. Should the machine be required for operational service it can be operated as a single-seater with the full fighter complement of four 20 mm guns. A cine camera in the nose operates for both rocket and gun firing, and can be used during dive-bombing attacks. Unstick speed is quoted as 95-100 kt and all-round flying characteristics are of a very high order. A typical average stalling speed, with undercarriage and flaps down, at the maximum landing weight of 10,500 lb, is 80 kt.

Chipmunk The design of the Chipmunk originated in Canada, and about a thousand machines of the type have been built, mostly in Great Britain. It is the standard primary trainer for the R.A.F. Volunteer Reserve, and other countries supplied are Belgium, Burma, Canada, Ceylon, Colombia, Denmark, Egypt, Eire, India, Indonesia, Iraq, Jordan, Lebanon, New Zealand, Portugal, Syria, Thailand and Uruguay. The engine is a Gipsy Major 8. Construction is all-metal and the undercarriage is fixed.

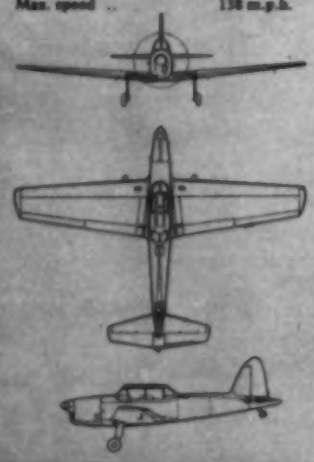


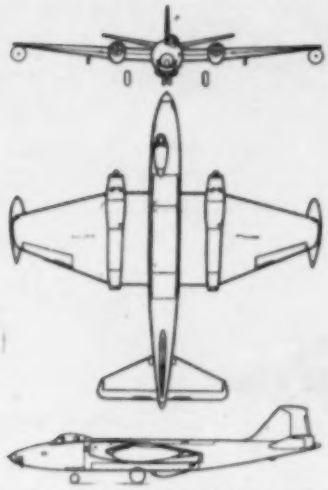
Power plant ...	D. H. Goblin 35
Span	38ft
Length	34ft 6in
Gross weight ...	11,640 lb
Max. speed	538 m.p.h.

Above, Vampire Trainer

Below, Chipmunk T.10

Power plant ...	D.H. Gipsy Major 8
Span	34ft 4in
Length	25ft 5in
Gross weight ...	2,014 lb
Max. speed ...	138 m.p.h.





Power plant ... Two Rolls-Royce Avon
Span 64ft
Length 65ft 6in

Above, Canberra B.8

Below, P.1

Power plant ... Two Armstrong Siddeley Sapphire
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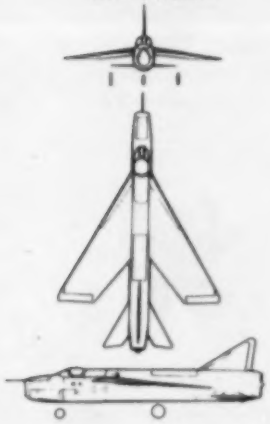


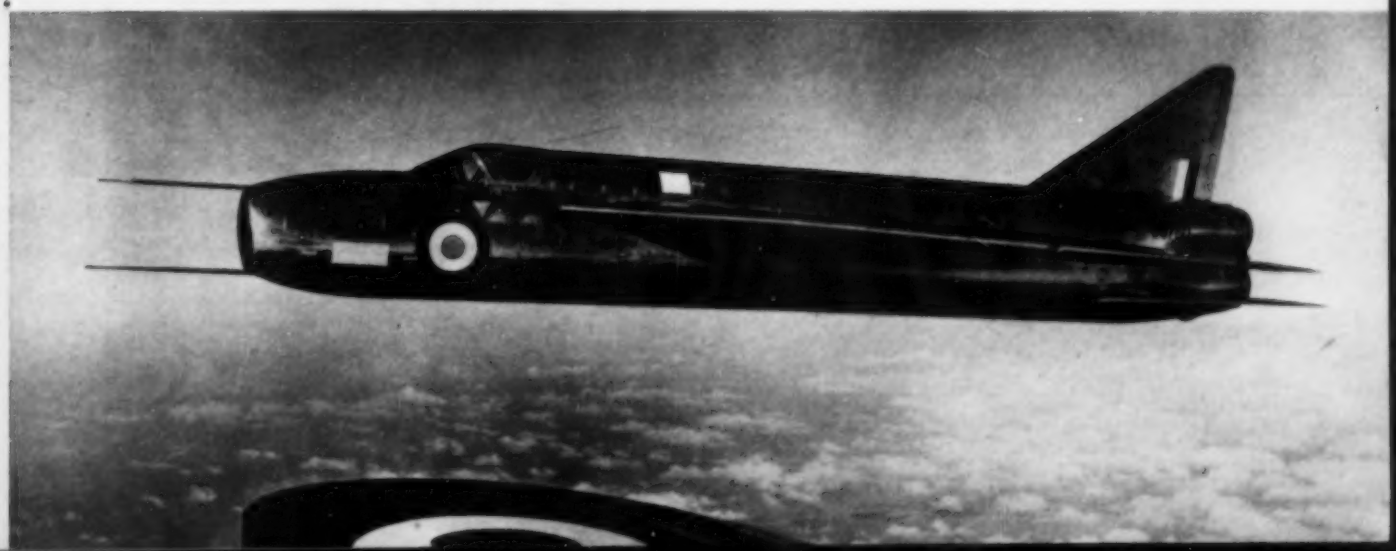
THE ENGLISH ELECTRIC CO., LTD. *Queen's House, Kingsway, London, W.C.2*
Telephone: Holborn 6966

P.1 When the first prototype of the P.1 supersonic single-seat fighter flew in August last year the Ministry of Supply announced that, in addition to the "usual prototypes," twenty pre-production aircraft had been ordered for development trials. These would make it possible to conduct many of the flying and equipment tests concurrently, and so shorten the development period. Since that time the first machine has regularly achieved supersonic speed in level flight without the use of reheat, for which provision is evidently made. Supersonic performance, according to the maker's chief test pilot, is "completely smooth and highly satisfactory." He adds that the machine handles perfectly at low speeds. The low-speed characteristics of such an aircraft, it will be understood, pose an extremely difficult problem. Therefore, after the basic design had been settled, following tests in the English Electric company's wind tunnels, Short Brothers and Harland, Ltd., were requested to design and build the S.B.5 research aircraft to determine the low-speed characteristics of the P.1. A brief description of the S.B.5 appears on page 379. The two Armstrong Siddeley Sapphire turbojets of the P.1 receive air through a deep nose intake. The nosewheel retracts forwards and the main undercarriage units outwards into the highly swept wing, at the extremities of which the ailerons are carried transversely. Similarly swept is the very low-set all-flying tailplane. The rudder is of very narrow chord. The first prototype P.1 was first demonstrated at the Golden Jubilee celebrations of the Royal Aircraft Establishment. *Flight* remarked, "Though its speed was well in the .9s, its rates of roll and turn were astounding." A second prototype flew recently.

Canberra Bombers The original version of the Canberra light bomber was the B.1, the first example of which flew in May 1949. There were only four aircraft of this model, which was intended as a "radar" bomber. The second development, the B.2, was a three-seater with a transparent bomb-sighting position in the nose, with cabin pressurization from engine compressors and having cartridge starters. The B.2 was the first version to go into quantity production. A "one-off" variant was the B.5 target-marker, having a large optically flat panel beneath the nose. Following the B.2 into quantity production came the B.6, with Avons of a later mark having triple-breech starters. Fuel capacity was increased. Some R.A.F. squadrons of the 2nd Allied Tactical Air Force in Germany are about to be equipped with a special version of the B.6 adapted for ground-attack operations at night. Bombs are carried beneath the wings and there is a 4 × 20 mm gun pack beneath the fuselage. The aircraft is an interim type pending the availability of the similarly armed B.8 night interdictor, later described.

The Canberra has been built in the United Kingdom not only by English Electric but by Short Brothers and Harland, Ltd., A. V. Roe and Co., Ltd., and Handley Page, Ltd., and is being produced under licence in Australia at the Government factory near Melbourne. The Australian version is designated B.20 and is modified to meet R.A.A.F. requirements. The Avon engines are manufactured in Australia by the Commonwealth Aircraft Corporation. In America a Sapphire-powered version is produced, under the designation B-57, by the Glenn L. Martin Co.

The wing of the Canberra is of low aspect ratio, with a root chord of 19ft. The single main spar is continuous through the fuselage, and finger-type air brakes are set in the top and bottom wing surfaces. The fuselage has a maximum diameter of 6ft, and the hydraulically operated bomb doors have rollers which, upon retraction, slide in curved tracks. The tailplane is of variable incidence type. The Rolls-Royce Avon turbojets are mounted forward

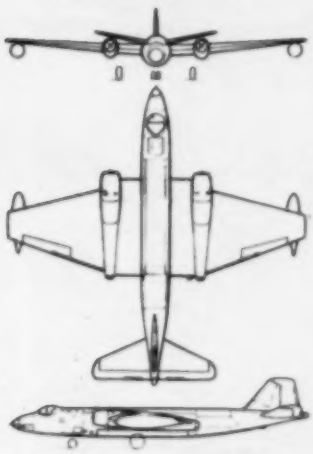


of the main spar, through which the jet-pipes pass. An experimental development, powered with two Bristol Olympus two-spool turbojets, established a world height record of 63,668ft on May 4th, 1953.

Canberra Night Intruder This two-seater version of the Canberra, sometimes known as an "interdictor," is the most versatile of the whole family, being designed to operate in two rôles. It can work over long ranges by night into enemy territory at medium and low levels, with the object of attacking ground targets, especially communications; or it can be used as a normal high-altitude bomber. For night intrusion it has a forward-firing armament of four 20 mm guns carried in a pack developed by Boulton Paul. An Alvis low loader is used to facilitate removal of the pack. Especially notable is the very large quantity of ammunition provided for each gun—of the order of 500 rounds. Bombs exhibited with the B.8 Canberra at last year's S.B.A.C. Display included a 1,000 lb medium-case and a 1,000 lb Mk 8. Behind the bomb bay is provision for an F.24 high-level camera. In respect of power plant and wing and tail structures the B.8 follows the B.6 and P.R.7; the nose, however, is completely new, with a very large bubble canopy offset to port for the pilot, and a single crew position in the nose. The bomb-aiming position is along the fuselage centre-line, with a centrally mounted window for the bomb-

Above, Canberra B.6

Below, Canberra P.R.7 (left) and Canberra T.4

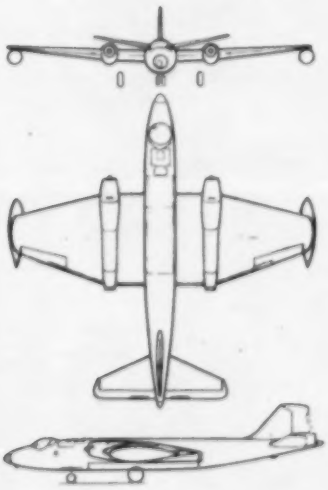


Above and right, Canberra P.R.9

Power plant ...	Two Rolls-Royce Avon
Span	68ft
Length	66ft 8in

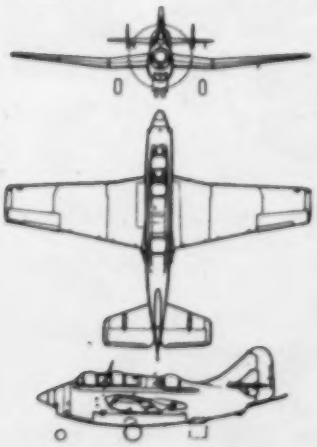
Below, Canberra B.6

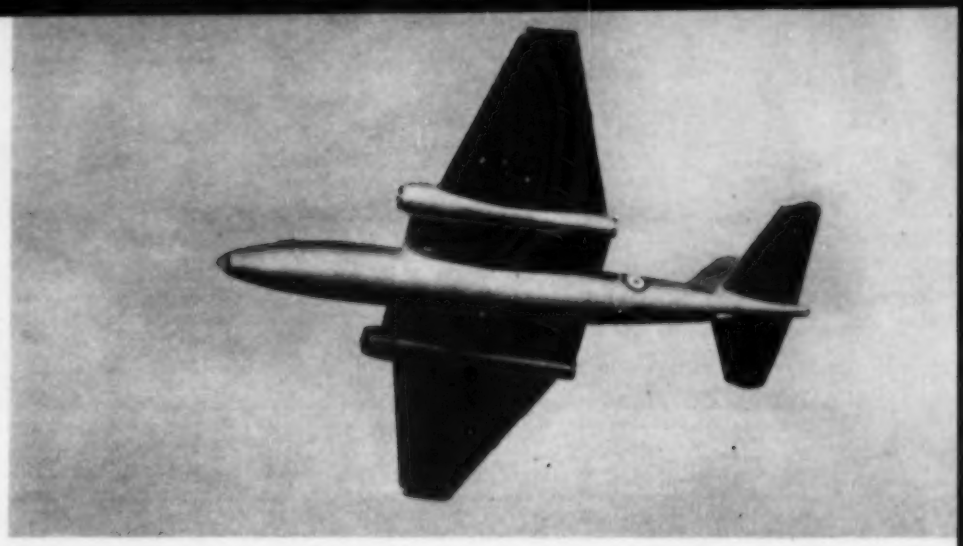
Power plant ...	Two Rolls-Royce Avon
Span	64ft
Length	65ft 6in



Below and right, Gannet A.S.1

Power plant ...	Armstrong Siddeley Double Mamba
Span	54ft 4in
Length	43ft





aimer. Superimposed on this is a rearward-facing seat with the weapon-selector switches and other gear ranged around it. Also in the nose is provision for a wide range of navigational equipment. Recently on test at the Ministry of Supply's experimental establishment at Defford, Worcestershire, was an experimental version of the Canberra having a large radar installation in the nose. Of this machine the English Electric company said, "It is apparent that the Canberra Mk 8, which is the first Canberra to carry guns, could, with its high fire-power combined with radar similar to that installed in this experimental aircraft, be adapted as an exceptionally effective night and all-weather fighter."

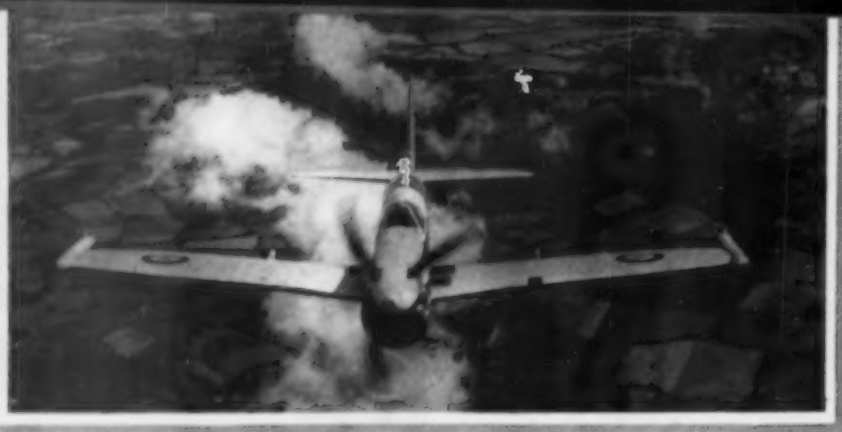
Canberra Reconnaissance Aircraft The first photographic reconnaissance version of the Canberra was the P.R.3, a counterpart of the B.2, but without the bomb-aiming panel. Fuselage length was increased to 66ft 8in. From the P.R.3 was developed the P.R.7, with more powerful Avons and additional fuel. The newest development is the P.R.9, with span increased to 68ft and having a considerably increased wing-chord inboard of the nacelles. Tank attachments are now slightly inset. The Canberra P.R.9 will be demonstrated for the first time at the S.B.A.C. Display this year.

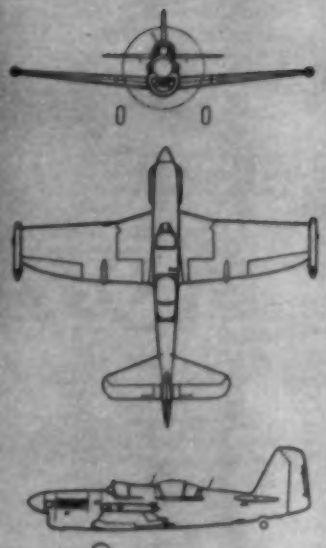
Canberra Trainer The Canberra T.4 carries a crew of three—a pupil and instructor, seated side by side with dual controls, and, to the rear, a navigator. This type is in service in the Royal Air Force.

FAIREY AVIATION CO., LTD.

Hayes, Middlesex.
Telephone: 3800

Gannet Carrier-borne anti-submarine squadrons of the Royal Navy are progressively being equipped with the A.S.1 version of this three-seat turbine-powered machine. The T.2 is a trainer variant and is likewise in service. Forty Gannets, of both marks, are on order for the Royal Australian Navy. The Gannet is a distant derivative of prototypes built to meet the GR.17/45 specification, the first of which flew in September 1949. While design was in progress, important developments in radar, armament and operational techniques came about; thus it was that the aircraft, originally a two-seater, was redesigned as a three-seater with new armament and numerous other modifications. Embodying the principal of these features, the third prototype flew in May 1951; meantime, a prototype GR.17/45 had performed deck-landing trials at sea. Between them the three prototypes made over 250 deck-landings, and in October 1953 the first production Gannet spent a trouble-free period at sea, making a number of deck-landings in poor weather and at night. The Armstrong Siddeley Mamba double turboprop was chosen for the Gannet because the Admiralty had decided to avoid carrying petrol aboard aircraft carriers. It was further realized that the specific fuel consumption of any turboprop was increased





Above, Firefly 8

Power plant	Rolls-Royce Griffon
Span	43ft 6in
Length	38ft 3in

with throttling, whereas the Gannet could normally cruise with one-half of the engine shut down, and with the second half operating under the most favourable circumstances. Furthermore, the life of the complete power plant would be prolonged and there was, of course, the consideration of safety. Other incidental factors were the low noise level, and the possibility of dispensing with cumbrous flame dampers. As illustrated on page 365, the Gannet's wing has a double fold, enabling the folded width to be kept down to 13ft 9in. An impressive weight, and a wide variety, of attack weapons (including, it is supposed, homing torpedoes) can be stowed internally, and external provision is made for sonobuoys, or other stores. For anti-submarine search a dielectric radome is lowered from the rear part of the fuselage. At numerous displays, the Gannet has demonstrated a lively performance and good all-round handling characteristics. The Gannet T.2 trainer has been developed to provide advanced training for crews in weapon and engine handling. The pupil is seated with the instructor in the second cockpit, wherein all controls are fully duplicated. (In the A.S.1 version, the second cockpit is normally occupied by the observer/navigator.) The T.2 version is also suitable for use as a communications aircraft, for the third cockpit will accommodate either a radio operator or two passengers.

Firefly Of the numerous variants of the Firefly, the most recent is the Mk 8, a radio-controlled target drone aircraft extensively used in connection with guided missile tests. A radio-controlled automatic pilot, in conjunction with electric actuators for throttle, airscrew, flaps and arrester hook, enables the machine to be operated without a human pilot, and each of the fairings at the wing-tips houses five cameras, surveying the entire field about the aircraft.

F.D.2 One of the fastest aircraft in the world, this supersonic research delta is a vastly different aircraft from its predecessor, the F.D.1. The aerodynamic form of its fuselage is much finer, the power plant is a Rolls-Royce Avon, with provision for reheat, and there is no tailplane as on the earlier machine. To assure the pilot of a good forward view for take-off, landing and

Below, Gannet T.2

taxying, the entire nose portion is hinged. The wing is, perhaps, the thinnest yet flown in this country, as will be gathered from the photograph above.

Rotodyne Two prototypes of this very large single-rotor helicopter are under construction, each to be powered by two Napier Eland NEl.3 turboprops of 3,000 h.p. each. The aircraft is expected to offer "a direct transportation challenge to the Douglas Dakota" and to be able to maintain height at maximum designed weight with one engine out, irrespective of the forward speed at which failure occurs. The Elands incorporate auxiliary compressors for the Fairey tip-mounted pressure jets. For take-off, these compressors are engaged and supply air through the hollow rotor blades to the jets; in these, the air is mixed with fuel and burnt to drive the rotor. Thus, the machine takes off as a helicopter, though sufficient power is directed to the forward-facing airscrews to provide directional control on the ground and in the air. When a pre-determined forward speed has been attained, the auxiliary compressors are declutched, and engine power is transferred to the airscrews. The rotor then auto-rotates to provide about half the lift of the aircraft, the other half being provided by a high-mounted fixed wing of 47ft span. The cabin offers 3,300 cu ft of unrestricted space, and the payload is 11,000 lb. Economical speed is to be not less than 150 m.p.h., and still-air range about 270 nautical miles. Representative loads could be: 44 passengers and baggage; 30 stretchers and ten attendants; three motor cars and 12 passengers; a continental touring coach and passengers; a Hawker Hunter fighter, without engine, and with wings removed; a jeep and a 25-pounder gun; 300 lambs or 150 sheep, or 20 cattle (alive or as carcasses); 4,000 cans of milk or beer; or four ultra-light helicopters.

Jet Gyrodyne This machine has been adapted from one of the two Gyrodyne prototypes to investigate problems associated with tip-jet propulsion. In place of the original three-blade rotor there is a large two-blade structure, carrying Fairey pressure-jets at the tips. The Alvis Leonides engine drives compressors which supply air to the jets for take-off and landing, but for cruising the greater part of the power is transferred to two pusher airscrews at the tips of the stub wings.

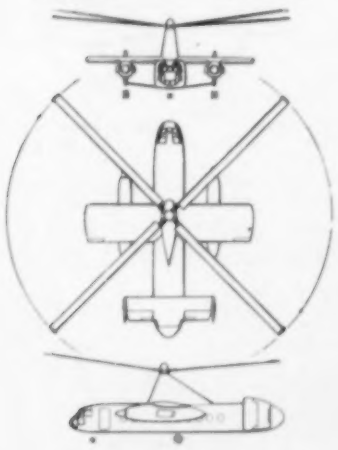
Ultra-Light Helicopter Built primarily to satisfy a requirement of the British Army, this two-seater is powered with a Blackburn-Turboméca Palouste and is suitable for communications and observation. The crew of two sit facing in opposite directions and are thus assured of an almost unrestricted view. The first prototype is expected at Farnborough.

Power plant ... Rolls-Royce Avon
Span 27ft
Length 52ft

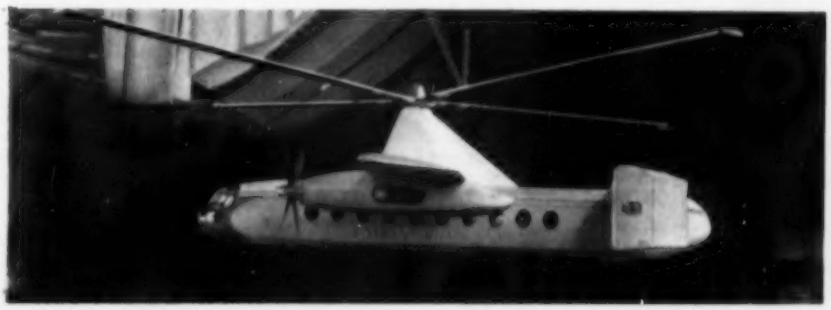
Above, F.D.2

Below and right, Rotodyne

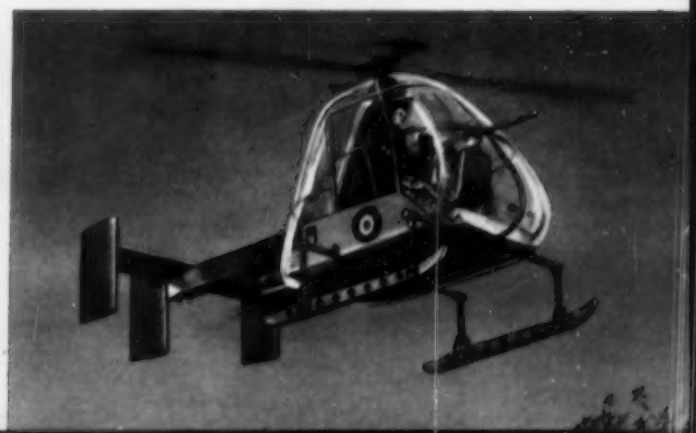
Power plant ... Two Napier Eland
Rotor diam. 90ft
Gross weight ... ... 33,000 lb

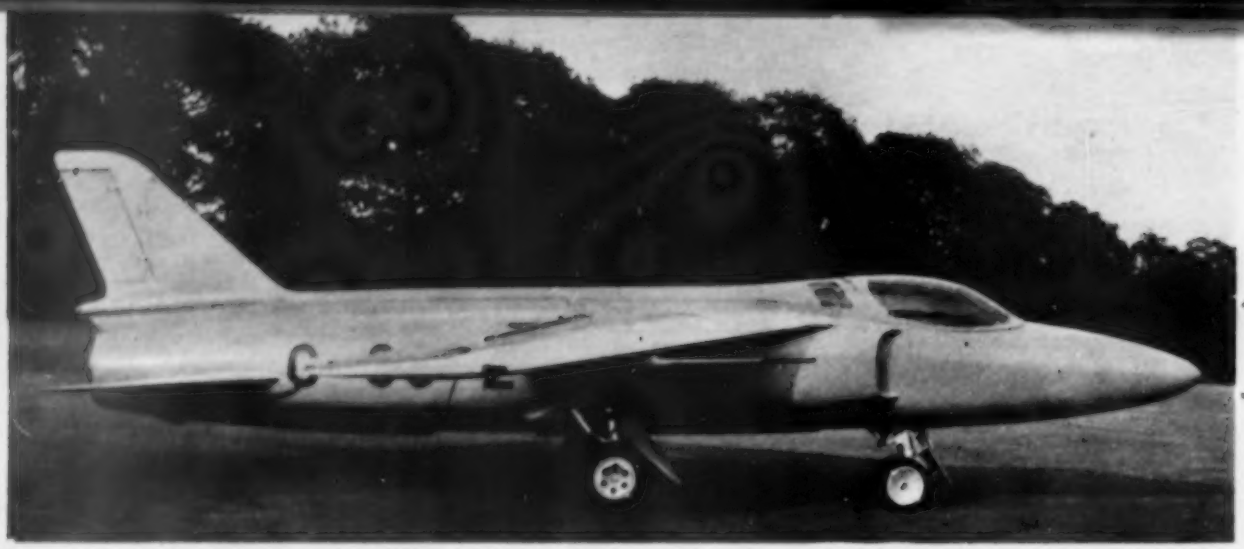


Below, Jet Gyrodyne



Below, Ultra-Light Helicopter





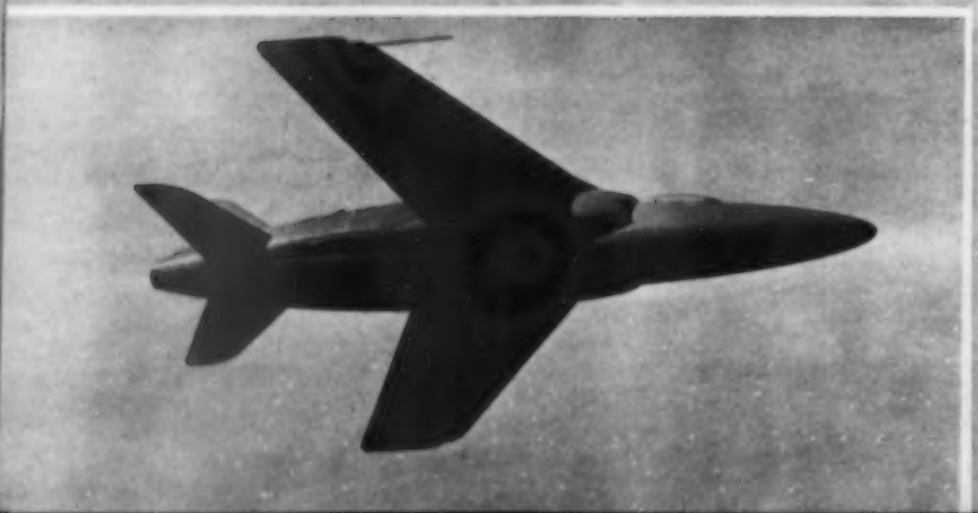
FOLLAND AIRCRAFT, LTD.

Sydney Lodge, Hamble, Hants.
Telephone: Hamble 3191

Midge and Gnat The light fighter, as championed by Folland Aircraft, is a small high-performance aircraft which can be produced at a fraction of the cost of a conventional fighter and, at the same time, perform most operations which might be required of any single-seat day fighter. It is felt that it could fill an important rôle in the struggle for air superiority, where numbers might be paramount, and also in the destruction of bombers under conditions where extensive search, and other, equipment would not be necessary. The Gnat is the outcome of a private venture undertaking and the concept dates from 1951. Construction was begun in 1953, and the first prototype, named Midge, was flown in August 1954, powered with an Armstrong Siddeley Viper turbojet. The first of the Gnats, with the Bristol Orpheus (for which the type is specifically designed), was initially flown on July 18th this year. In layout, the Gnat is unusual in having a high wing, power-operated inboard ailerons, and no independently operated air brakes. No tanks, guns or undercarriage components are housed in the wing. The high wing/low tail combination is said to afford the advantage that excessive downwash from the wing does not strike the tailplane during turns, and other manœuvres, and thus destroy its stabilizing effect. The inboard ailerons give an exceptionally high rate of roll (at least 200 ft/sec) without imposing undue twisting forces on the wing. Air brakes are in the form of metal fairings attached directly to the three legs of the undercarriage. The small span allows the wing to be built in one piece, and a trained crew can change a Gnat wing in less than 12 hours—about half the time taken for a similar operation on a standard fighter. Armament is two 30 mm Aden guns, with their barrels in the air-intake fairings. Standard equipment includes VHF radio and standby, gyro gunsight and radar ranging, supplementary oxygen, braking parachute, and lightweight, fully automatic ejection seat. As a fighter/bomber, the Gnat can carry two 500 lb bombs, or 12 3in R.P.s. Performance details are withheld (especially so as the Ministry of Supply has placed a small order); the Midge, however, frequently demonstrated its supersonic capabilities in shallow dives. The first two of these dives—on the same day—was started at about 37,000ft and supersonic speed was reached at about 24,000ft, and held for five or six seconds. The Midge is reported to have behaved normally throughout the dives, and only a slight trim change occurred when Mach 1 was attained. Reference has been made in the foreign press to a Gnat 2 interceptor having an Orpheus with reheat and weighing rather less than 10,500 lb. It would have a wing of 6 per cent thickness. At the time of writing, handling reports on the Gnat are not available. Of the Midge, however, it can be said that the stall began at about 105 kt true, but it was not fully developed until the control column was right back. Nor was there any tendency towards instability at any stage of the stall. Lateral, directional and longitudinal stability was good and no buffeting occurred up to speeds in excess of Mach 1.

Gnat

Power plant	Bristol Orpheus
Span	22ft 2in
Length	29ft

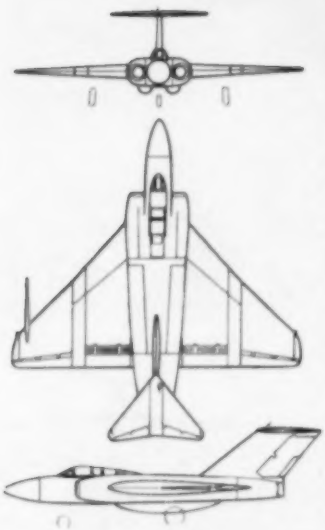


Above, Gnat

Left, Midge

GLOSTER AIRCRAFT CO., LTD.

Hucclecote, Glos.
Telephone: Gloucester 66294



Javelin FAW.1

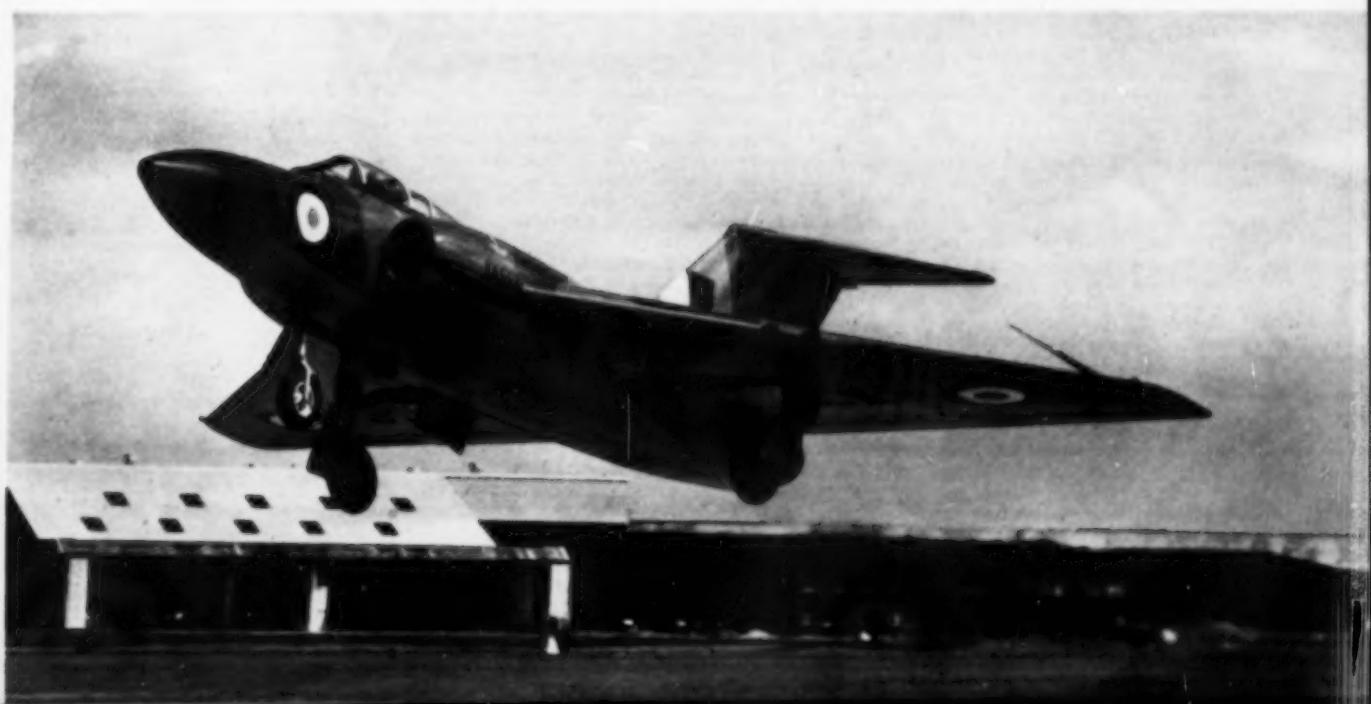
Power plant ...	Two Armstrong Siddeley Sapphire
Span	52ft
Length	57ft

Javelin In April 1954, the Under-Secretary of State for Air then in office stated in the House of Commons that it would be difficult to exaggerate the importance of the Javelin, and that as a fighting weapon, equipped with modern armament and modern radar capable of finding and attacking the enemy in all conditions, many new tactical opportunities would be opened up to improve the quality of our day and night defence. Since that time the Javelin has been under continuous development, and has frequently attained supersonic speed in the dive. It has, however, come in for its full share of unfavourable comment, and in reply to one recent attack, the following points were made by the Hawker Siddeley Group. (a) Deliveries will be made as planned this year to the R.A.F. (b) Javelin performance in almost all respects is better than original design expectations, and this includes speed, take-off, landing and high Mach number performance. (c) The record of Javelin crashes, of which there have been three, compares favourably with that of other high-speed aircraft, both British and American. Aerodynamic reasons for two of the three crashes are fully understood. The reasons for the third crash are also understood and they are not aerodynamic.

Changes embodied in the Javelin during the course of development have been a decrease in sweep-back on the outer panel leading edges to give a better fineness ratio over the ailerons, and the adoption of a clear-view canopy. A number of different shapes for the radar nose have been tried. The Javelin was built to Specification F.4/48 calling for a night and all-weather fighter of very high performance, yet having a long endurance and carrying very heavy armament and the most comprehensive electronic aids. The first prototype flew in November 1951, and the type was ordered into quantity production in July 1952. The first production machine was in the air two years later, and together with the third, flew (and flew very impressively) in company with three of the prototypes at the S.B.A.C. display last year. The built-in armament of four 30 mm Aden guns is carried in the wings. Two auxiliary tanks can be attached beneath the Armstrong Siddeley Sapphires (although the internal tankage is great) and provision will be made for guided missiles, either, it may be supposed, beneath the wings or at the tips. Unlike other deltas, the Javelin is fitted with a tailplane, and this permits the fitting of wing flaps which make a valuable contribution to the qualities of the Javelin as a night-flying aircraft. The design layout lends itself not only to the installation of larger Sapphires, but of other types of turbojet, with or without afterburners, and the makers have claimed that the aircraft is capable of using all the increases in engine power that could be anticipated in the foreseeable future. With the present engines, a great number of flights have been made at heights in excess of 50,000ft. In respect of altitude performance, of course, the Javelin is at a great advantage in having a low wing loading, and a further aid to manœuvrability is the tailplane which, being movable in conjunction with the elevators, ensures good manœuvrability at all heights and speeds.

In March this year, it was officially announced that a new all-weather fighter is being developed from the present Javelin, and according to American reports, this aircraft will be powered by Bristol Olympus turbojets.

Meteor The Meteor—already a historic aircraft—is no longer in production, output having ceased after more than ten years. Many hundreds, however, remain in service, and these are principally of the following marks: T.7, a tandem-seat dual-control trainer having a span of 37ft 2in, and a maximum speed of 590 m.p.h. F.8, a single-seat day intercepter or fighter/bomber, having a redesigned tail, a top speed of 592 m.p.h., and an armament of four 20 mm guns. F.R.9, fighter reconnaissance version of the F.8 with provision for cameras, but retaining the four guns. P.R.10, fitted with the long-span (43ft) wing, having a camera nose similar to that of the Mk 9, and additional photographic provision in the rear fuselage. T.7/8, the T.7 with the F.8 tail.



HANDLEY PAGE, LTD.

Cricklewood, London, N.W.2
Telephone: Gladstone 8000

Victor Throughout the past year, development of the Victor B.1 four-jet bomber has gone ahead with the most encouraging success. In April this year, the Under-Secretary of State for Air flew the prototype to a height of over 50,000ft and at high Mach number. He himself made the landing, and when congratulated, remarked "The Victor does it for you." By this he had in mind the strong tendency of the Victor to trim nose-up as ground effect comes into play, thus conferring valuable self-landing characteristics. The chief test pilot of Handley Page is firmly of the opinion that any pilot can bring the Victor in gently with power on and air brakes in operation in rain or in bad visibility, and that all he need do is to correct for local air disturbances affecting lateral trim, until the wheels of the main bogie undercarriage touch down. Thereupon the nosewheel is brought on to the runway and the brakes applied. This quality of the Victor is, however, an incidental one, for the characteristic crescent wing layout was chosen —in the words of a Handley Page technician—on performance grounds. The specification had called for long range, good load-carrying ability, high subsonic cruising speed and high cruising altitude, but none of the layouts studied was right for every application. In general, a moderately high aspect ratio was found to be required with a pronounced angle of sweep-back to give a high critical Mach number. Heavy sweep in conjunction with high aspect ratio, however, produced unfavourable pitching behaviour at the stall, and tip-stalling problems became particularly acute. The adoption of the crescent, then, was essentially a working compromise between two methods of overcoming the difficulties, i.e., between high sweep and low aspect ratio, and moderate sweep on a thin wing of reasonably high aspect ratio. By progressively reducing both sweep and thickness/chord ratio, a constant critical Mach number along the span was obtained. It was found that the thick wing root was suitable for stowage purposes, and the overall structure-weight penalty did not prove too great. The highly swept root, which did not stall easily, resulted in a tip-stalling problem, but this difficulty was remedied by careful design of the wing/fuselage intersection. Under high-speed stall conditions, the performance of the crescent wing showed to advantage, particularly good behaviour being apparent in high-g turns.

The need to vary the sweep and thickness/chord ratio to obtain the constant critical Mach number involved much calculation and experimental work in order to determine the pressure distributions and the most suitable wing geometry, and the Royal Aircraft Establishment co-operated in the necessary high-speed tunnel tests. Stability and control characteristics under conditions of unseparated flow were little different from those of a conventional swept wing of the same average sweepback angle. The sweepback reduction at the tip of the wing, however, had to be limited because of the danger of a loss of aileron effect. Nevertheless, aileron power at low speeds was an improvement over that of the straight swept wing.

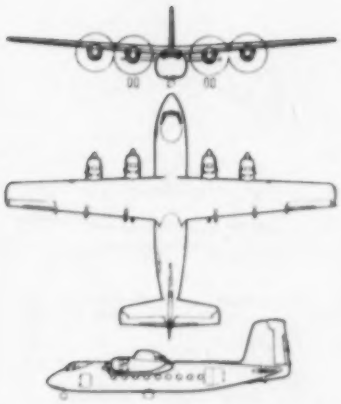
The Armstrong Siddeley Sapphires are installed close against the fuselage within the wing and take in air through wing-root intakes of very subtle design. The outermost panels of the wing itself have droop-snoot leading-edge flaps, each in two sections; the rearward-moving trailing edge flaps are shaped to the jet-nacelle contours; and there are large, hinged air-brake panels on the tail cone to increase drag for deceleration in flight and upon landing. The Victor has powered controls with progressive feel simulation. Internal bomb capacity is great and additional bombs may be carried in streamlined containers beneath the wings.

Victor B.1

Power plant	...	Four Armstrong Siddeley Sapphire
Span	...	110ft
Length	...	114ft 11in

HANDLEY PAGE (READING) LTD.

The Aerodrome, Woodley, Berks.
Telephone: Sonning 2211



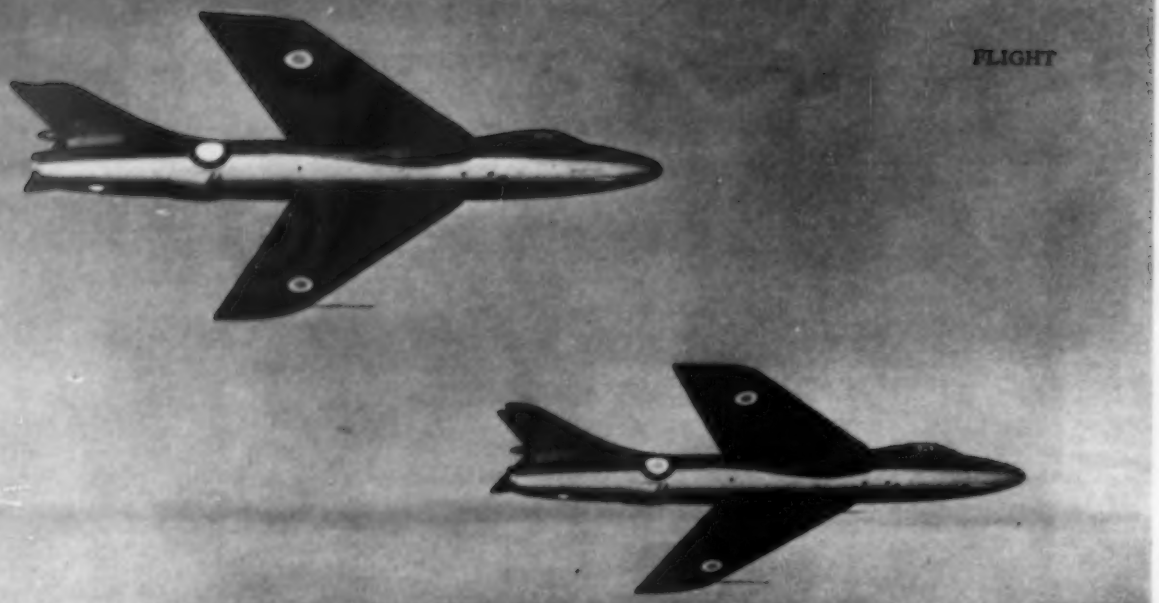
Herald

Power plant ...	Four	Alvis Leonides Major
Span	... ...	95ft
Length ...	... ...	70ft 3in
Gross weight	... ...	34,000 lb
Max. speed ...	...	263 m.p.h.

Herald Orders by Australian National Airways, Queensland Airlines and Lloyd Aero Colombiano have been announced by Handley Page for the Herald four-engined feeder-liner (or branch-liner, as it has been styled). A robust high-wing monoplane, the Herald is powered with four Alvis Leonides Major piston engines. In the centre section of the wing there are no heavy spar booms, and the skin—a metal sandwich composed of a corrugated filler spot-welded to inner and outer skins—carries bending and end loads. It is foreseen that avoidance of highly stressed booms, susceptible to fatigue, will greatly increase the life of the wing. Shear loads are taken by three lightly loaded web members. The outer wings are attached to the centre section by numerous bolts which carry the load from the outer wings into the sandwich skin-panels. The centre section comprises a centre box, leading edge and trailing edge. The centre box has a corrugated metal sandwich-skin and three vertical webs, the centre web being a corrugated metal sandwich, and the other webs built up of stiffened light-alloy plate. Normal stressed-skin construction is used for the outer wings and for the fuselage also. In the tail, however, a departure from normal practice is noticed in the use of fluted skin, rendering the tail extremely simple by reducing internal structure to a minimum.

The quickly detachable cabin seats allow rapid conversion for any of the Herald's three rôles (airliner, freighter, or airliner/freighter) to another. The seats themselves are of low weight and capable of withstanding 9 g fore and aft loads. Attachment sockets allow them to be mounted facing either forward or aft on each side of a central gangway, and they can be spaced at 38in or 33½in pitch. In the former case 36 passengers can be accommodated; in the latter, 44 passengers. Each seat is mounted at three points. Two lateral tubes, forming the base of the seat, push into two sockets in a longitudinal member on the cabin wall, and a single vertical leg beside the gangway is keyed to a socket in the floor and secured by a retaining place and quick-release pin. The bulkheads, which form the front and rear of the passenger cabin and the wall of the toilet compartment, are attached to the fuselage frames by spring-loaded bolts and spigots. These enable the bulkheads to be removed easily from the aircraft when it is to be converted into a freighter. Alternatively, the front freight compartment can be enlarged by moving the forward bulkhead back to one of the several positions. As a freighter only, the Herald's total volume of freight space is 1,575 cu ft, with gangways clear. As an airliner with a seating capacity of 44, a cabin floor area of 220 sq ft is available. The bulkheads, in this arrangement, divide the fuselage to give 90.5 cu ft of space forward of the cabin. The rear freight capacity of 171 cu ft is constant for all passenger layouts. Passengers can sit where they wish in the cabin provided that the first 650 lb of freight is placed in the rear hold and remaining freight added in the ratio of 2 lb in the rear hold to every 1 lb in the front hold. As a combined airliner/freighter with a seating capacity of 36, the floor area of the cabin is 204 sq ft; the bulkheads, in this instance, give a forward freight space of 183.5 cu ft. When 24 passengers and freight are carried, the floor area of the cabin is 166.8 sq ft. Forward freight hold capacity is, in this case, 469.5 cu ft.

Control and instrument arrangement is such that the Herald can be operated normally with a flight crew of two or—for ferrying purposes—with only one. A radio operator's station can be provided, if needed. Full dual flying controls are standard.

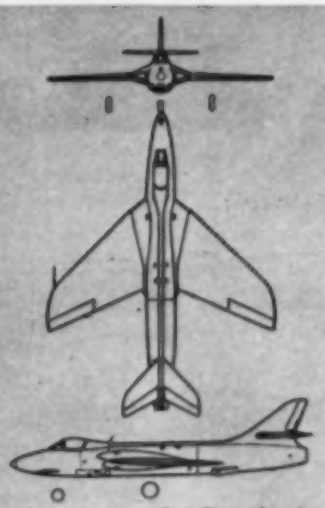


HAWKER AIRCRAFT, LTD.

Canbury Park Road, Kingston-upon-Thames, Surrey
Telephone: Kingston 1044

Hunter The Hunter will be represented at this year's S.B.A.C. display not only by individual demonstration aircraft entered by the manufacturers (including the Hunter two-seater) but by a sizeable R.A.F. formation and an R.A.F. aerobatic team. The type is now well established in the United Kingdom and abroad, in three marks. The F.1 has the Rolls-Royce Avon turbojet and the F.2 the Armstrong Siddeley Sapphire; the F.3 was a proposed re-heat version, now abandoned. Marks F.4 and F.5 are similar to the F.1 and F.2 respectively, but have increased internal tankage. The so-called "Hunter variant" which made its debut at last year's Display was, in fact, an F.1 airframe adapted to take a more powerful Avon and is regarded as a prototype for the new F.6, to appear this year. This newest fighter mark has a yet more powerful mark of Avon. A number of Hunters are now flying with pylon-mounted finless plastic under-wing fuel tanks and it is known that under-wing armament loads are possible. The Hunter two-seater, which has been on test since July 8th, but has not hitherto been demonstrated, is "intended to open up opportunities for even wider tactical rôles."

Hunter fighters (which are on order not only for the R.A.F. but for Belgium, the Netherlands and Sweden also) are popular with their pilots and the following excerpts from *Flight's* report from a visit to an R.A.F. Hunter station speak for themselves. "One of the most impressive aspects of the Hunter—and there are many—is the way in which it has been accepted by the squadron pilots. It is remarkable that an aircraft which introduces in one step so many new features should, in fact, prove to be so easy to handle. Everything seems as straightforward as one could wish. One of the aircraft's most important qualities is that, while being easy to fly, it gives the pilots a performance which they have been longing for these many years. At last they can face the Canberra with the sure knowledge that it cannot get away from them—still less be able to indulge in the highly shaming quarter attack on the fighter which has been known to Meteor pilots. Before the Hunter reached the squadrons a number of its handling characteristics took on the proportions of bogies, but when it arrived the bogies did not materialize. Careful briefing, well-learned drill and, above all, happy experience, showed them for what they were. . . . The slow-speed flying characteristics of the Hunter are such that a G.C.A. approach in close pairs is quite comfortable at a very moderate air speed."



Power plant ...	Rolls-Royce Avon/ A.S. Sapphire
Span	33ft 8in
Length	45ft 3in

Above, Hunter F.1, 2, 4 and 5

Below, Hunter Two-Seater

Power plant ...	Rolls-Royce Avon
Span	33ft 8in
Length	48ft 10½in

Power plant	Armstrong Siddeley Viper 5
Span	35ft 5in
Length	31ft 11in
Gross weight	5,950lb
Max. speed	323 m.p.h.

Above, Jet Provost

Below, Provost T.1

Power plant	Alvis Leonides 25
Span	32ft 2in
Length	28ft 8in
Gross weight	4,300 lb
Max. speed	200 m.p.h.

HUNTING PERCIVAL AIRCRAFT, LTD.

The Airport, Luton, Beds.
Telephone: Luton 6060

Jet Provost An order for a small service-test quantity of these *ab initio* jet trainers was placed by the Ministry of Supply on behalf of the R.A.F. in March 1953, and although no large-scale order has yet been forthcoming, this would appear to be only a matter of time. It is expected that the particular Jet Provost to be demonstrated in the S.B.A.C. display this year will be a cleaned-up version, more closely approximating to ultimate production standard than the first machine and having a shortened undercarriage. (See drawing herewith).

The Jet Provost is an all-metal aircraft developed from the Provost, powered with an Armstrong Siddeley Viper 101 turbojet, and having pupil and instructor seated side-by-side. The wing has been modified, principally to accommodate additional tankage and the legs of the retractable undercarriage. Unlike that of the Provost, the fuselage is built in two parts; the cockpit is unpressurized. Immediately forward of the slotted wing-flaps are fitted the air brakes (below the wing) and spoilers (above), both sets of surfaces folding flush into recesses. Being mechanically linked, the air brakes and spoilers cannot be used independently. Their primary purpose is to assist manœuvring and formation flying. There is an amber-screen installation for simulated instrument practice, and the Jet Provost can be armed, if desired, with a pair of nose-mounted 0.303in guns, and under-wing loads similar to those carried by the Armed Provost, and later described. Thus equipped, the machine might be used for police duties or weapons training. The entire engine compartment is lined with stainless steel sheet, and equipment includes 14 self-setting flame switches. A total of 171 gallons of kerosine is normally carried in the wings and a non-jettisonable 50-gallon tank can, if required, be mounted under each wing-tip.

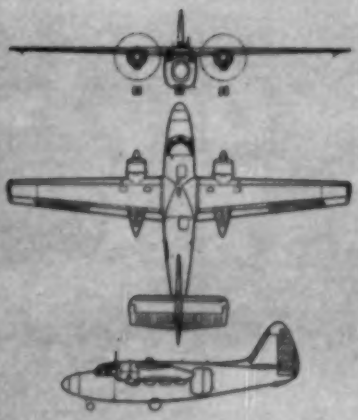
Provost and Armed Provost The Provost T.1 is the standard two-seat basic trainer of the Royal Air Force, and similar machines have been delivered to the Eire Air Corps. A "police" version, designated Armed Provost, has been supplied to the Air Forces of Southern Rhodesia and Burma. In all cases, the engine is an Alvis Leonides. Construction is all-metal, and the

undercarriage is fixed. VHF and TBA (tuneable beam approach) radio is installed, and there are adjustable amber screens for simulated blind-flying training. The canopy may be opened for contact flying and is completely jettisonable in emergency. Manœuvrability is of an exceptional order for a machine of this type, the rate of roll being more than 90 deg/sec. The side-by-side seating arrangement offers distinct advantages in the armament-training rôle, for the instructor can demonstrate and observe sighting techniques during air-to-air and air-to-ground firing practice. Standard loads for the Armed Provost are two 0.303in wing-mounted guns with 1,200 rounds of ammunition, two 250-lb bombs, or eight 25-lb bombs, or eight 25-lb bombs plus four 60-lb rocket projectiles, or six 60-lb rocket projectiles.

Pembroke The Pembroke is a high-wing, twin-engined multi-purpose military aircraft supplied to the R.A.F., Belgium, Finland and Southern Rhodesia. It is derived from the earlier Prince and Sea Prince Series, used by numerous Air Forces and civil operators, and is principally distinguished from those machines by a wing of extended span (64ft 6in against 56ft) and a longer nose. As used in the R.A.F. the Pembroke C.1 is primarily an eight-seat communications aircraft, though it is adaptable also for freighting, long-range ferrying and casualty evacuation. With the seats removed, the cabin affords an unobstructed space measuring 20ft 1in in length, 5ft 6in in width and 6ft in height (all figures maximum). The cabin doors measure 5ft 2in by 4ft 2in and loading is simplified by the low floor level. The Survey Pembroke for the Belgian Air Force (photograph above) incorporates modifications, consisting primarily of the substitution of a clear-view photographic sighting nose for the normal nose, and the fitting of vertical and oblique camera apertures in the fuselage. Provision is also made for forward oblique photography.

Prince Series V This civil version of the Pembroke is offered to operators of charter and feeder services as a ten-seater for stages up to 650 miles. For shorter distances, it will carry 12 passengers. The Alvis Leonides engines drive three-bladed fully feathering airscrews which can incorporate a reverse braking device if required. The Prince V also incorporates the dual wheel-brake systems of the Pembroke.

P.74 This single-rotor helicopter, with accommodation for a crew of two and eight passengers or an equivalent freight load, is powered with two Napier Oryx NOr.1 turbo-gas generators, mounted side-by-side beneath the floor of the forward half of the cabin. The prototype should fly late this year. The crew are seated side-by-side in the nose, and the passenger cabin is divided into two parts, with four seats in each. The gas produced by the two Oryx is fed by means of vertical ducting on each side of the fuselage between the two cabin compartments and converging above the cabin to pass through the hollow rotor



Power plant ...	Two Alvis Leonides
Span	64ft 6in
Length	46ft
Gross weight	13,000 lb
Max. speed	220 m.p.h.

Above, Pembroke

Below, P.74

Power plant	Napier Oryx
Gross weight	7,750lb
Cruising speed ...	120 m.p.h.

P.105

Prince

Retaining the versatility of the military Pembroke from which it has been developed, the Prince V has a range of 660 nautical miles in I.F.R. conditions carrying 12 passengers (plus 44 lbs. of luggage each), in either rearward or forward facing seats.

Pembroke (Two 550 h.p. Alvis 'Leonides')

Many examples of this versatile aircraft are already in world wide service with the Air Forces of Great Britain, Rhodesia, Belgium and Sweden. Its duties include communications, freighting, casualty evacuation, supplies dropping, twin engine pilot training and aerial photography.

Provost (Alvis 'Leonides')

The standard ab initio basic trainer of the Royal Air Force and already adopted for pilot training by the Air Forces of Rhodesia, Eire, Burma and Iraq. The Armed Provost is fitted with guns, bombs and rocket projectiles for weapons training and use as a tactical weapon.

Jet Provost (Armstrong Siddeley 'Viper 5')

Designed expressly for ab initio and basic flying training, the Jet Provost retains the docile and pleasant handling characteristics so necessary in the early stages of pilot training, already proven in the piston engine Provost.

Production and Development

P74, Helicopter

A general purpose research helicopter employing tip drive without torque. Two Napier 'Oryx' high efficiency low pressure turbo gas generators supply gas through the rotor blades to jets at the tips. Designed for simplicity, ease of maintenance, low noise level and high payload.

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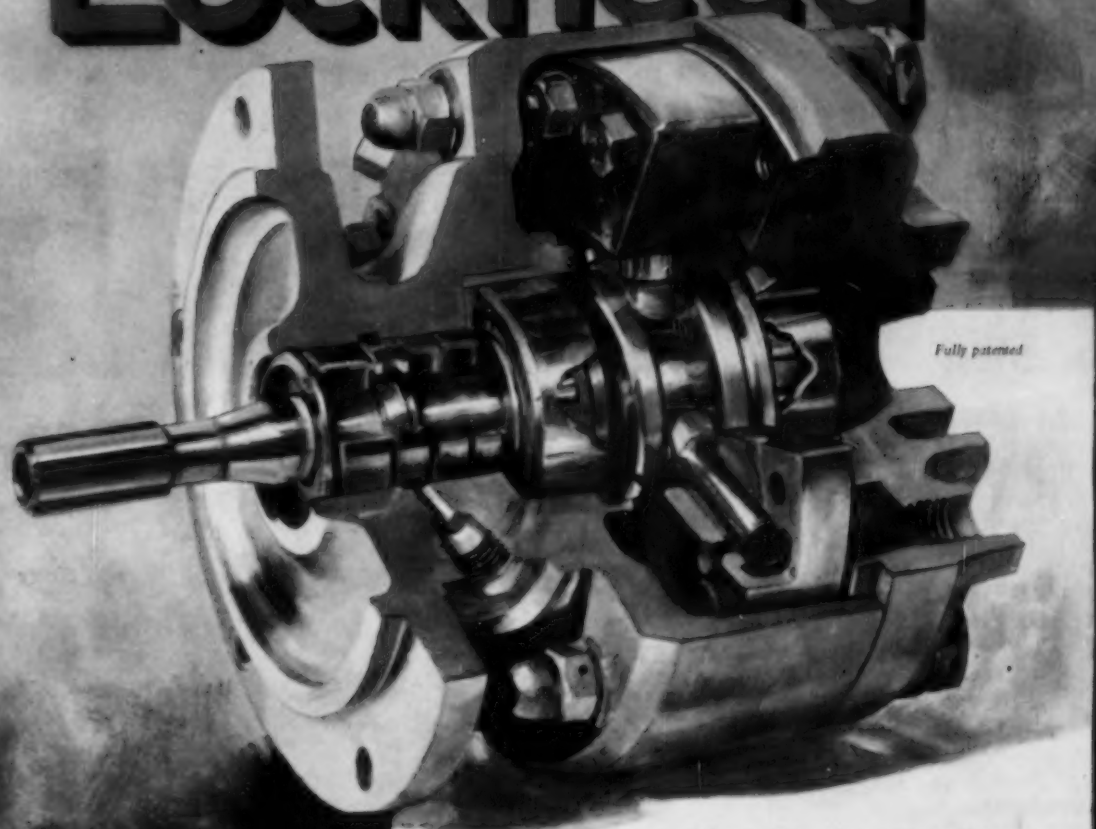
Lockheed



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The Lockheed Mark 7 pump is one of the famous Lockheed range of engine-driven pumps, and the widely-used Mark 8 pump is in effect a two-bank version of the Mark 7.

These pumps have earned a fine reputation and form the heart of the hydraulic system of many fine aircraft.

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PROBLEMS OF FLIGHT

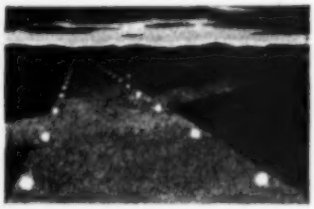
LIGHTS AND BEACONS

Night-flying is full of difficulties. Navigation apart, the risk of collision apart, there is the difficulty of identifying the runway from the air, and the difficulty of identifying an incoming aircraft from the ground.

The problem has been solved partly by the use of lights. Aircraft carry navigation lights; airfields are identified by lights; runways are defined by lights. A simple and logical solution — and one devised by Nature for many of her creatures in the early youth of life on this planet.

Luminescence in living creatures is widespread. (Even some plants are luminous — bacteria in rotting fish and fungi in dead wood.) The most striking examples in the animal kingdom are glow-worms, deep-sea fish, and phosphorescent creatures of the sea's surface. Their light occupies the whole visible spectrum, without infra-red or ultra violet. It is produced by the oxidation of various chemically-complex substances made in specially-developed cells.

Why? In the case of bacteria one twenty-five-thousandth of an inch in diameter, luminescence is probably an accidental by-product of some organic process. In the luminous protozoa, minute star-fish, and other drifting surface creatures, there may be a reason for the light — but we do not know it. Of the creatures who live in the perpetual darkness of the deepest seas, some probably use



light to see by, some to repel enemies, some to attract prey. But this is guesswork.

Only in glow-worms is the reason clear. These flashing, dancing miniature beacons use their light-signals to attract and identify each other. (An expert can tell the kind of glow-worm — there are many species — from the length of the flashes and the intervals between them.) Exactly-timed, unmistakably recognizable, the glow-worm's light is a perfect way of announcing his identity and whereabouts.

Man, in his recent invention of aircraft navigation lights and airfield identification lights, has borrowed yet another of Nature's ancient devices.

Pilots who land by night or day at airfields all over Britain have come to value the excellent and helpful service of the Shell and BP Aviation Service.

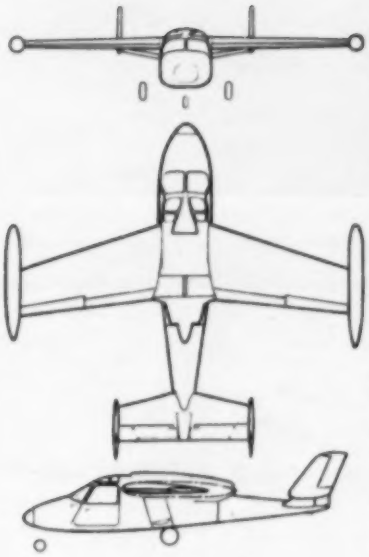
SHELL and BP AVIATION SERVICE

Shell-Mex and B.P. Ltd., Shell-Mex House, Strand, W.C.2.
Distributors in the United Kingdom for the Shell, BP and Eagle Groups.

Copies of this advertisement obtainable from Shell-Mex House, Strand, W.C.1.

head into each blade, finally discharging through nozzles at the blade tips. An auxiliary gearbox, driven from the rotor shaft, provides electrical and other services including—on the prototype at least—the drive for a small tail rotor. In each gas duct is a valve controlled from the cockpit, which, by diverting gas streams through vents in the fuselage, enables the power units to be run at full output on the ground. Moreover, these valves are the means of ensuring that, in the event of an engine failure, a reverse flow does not take place through the dead engine. Fuel tanks are located beneath the floor of the cabin. The fuselage and three-blade rotor are of all-metal construction, the latter of stainless steel.

P.105 A multi-purpose helicopter, this machine would embody experience gained with the P.74. It is one of a family of designs, all utilizing the same rotor/generator unit. Seating would be provided for ten passengers, and a crew of two, and cruising speed should be 100 m.p.h. for a range of 150/165 miles. Engines will be Oryx NOr4s.



Power plant	**One Blackburn Turbo-méca Marboré 2 or two Palas 600**
Span	28ft
Length	27ft
Gross weight	3,100/3,600
Max. speed (Marboré)	300 m.p.h. approx.

Above, Student

F. G. MILES, LTD.

Shoreham Airport, Shoreham
Telephone; Shoreham 2301

Student A descendent of the Magister and Master, famous before and during the war, the Student is a wholly modern single- or twin-jet trainer with side-by-side seating, and adaptable, as a four-seater, for fast communications work, or in emergency for ground attack. Thought has also been given to an A.O.P. version with a centre-section of increased span, full-span slots and slightly modified flaps. A bogie landing gear has been projected for this model to give rough-ground efficiency, and special observation windows and a camera installation would be fitted in place of the right-hand controls. The Student will be available either with one Blackburn Marboré 2, or two Palas 600s. Very large doors are provided and the floor of the aircraft is only 18in above ground level. The undercarriage retracts into the fuselage. Rocket "pods" can be carried under the wings, as shown above.

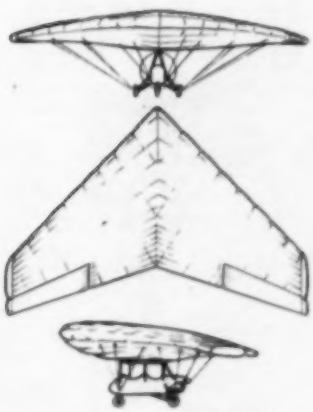
Aries The Aries is a development of the Gemini four-seater, differing in having more powerful engines (Cirrus Major IIIs) installed in new engine bearers; revised nacelles; structural strengthening; and re-designed tail surfaces to give greatly increased stability and safer characteristics with one engine out. Greater attention has been paid to passenger comfort and sound proofing.

Sparrowjet The first light jet-propelled racing aircraft to be built in Great Britain, this tiny machine is a development of the piston-engined Sparrowhawk powered by two Turbo-méca Palas turbojets. The undercarriage is fixed.

HDM. 105 For many months now, F. G. Miles, Ltd., have been British and Commonwealth representatives for the Société des Avions Hurel-Dubois, and the HDM. 105 is the first joint project to be undertaken. Essentially it comprises an existing Aerovan fuselage with a Hurel-Dubois type wing of 21 aspect ratio and 75ft span. A new undercarriage is being fitted, and the engines are Cirrus Major IIIs.

Below, M.L. Utility

Power plant	**Walter Mikron**
Span	39ft
Length	25ft



M. L. AVIATION CO., LTD.

White Waltham Aerodrome, Maidenhead, Berks.
Telephone: Littlewick Green 248

Utility Aircraft This highly unorthodox machine is intended as the prototype of various derivatives, for military and civil use. Its essential feature is an inflatable wing, carrying a separate cockpit structure below. A wing of this kind is cheap and light, and when the aircraft is not in use, can be rolled up and placed in a container for transportation in a jeep or other vehicle, the chassis portion of the aircraft being towed behind. No more than 50 h.p. is required for flight, and with petrol for 100 miles the present machine weighs only 550 lb and will carry a useful load of some 400 lb. Take-off and landing speeds into wind are of the order of about 18 m.p.h. and cruising speed about 45 m.p.h. (Drawing shows future version).

SAUNDERS-ROE, LTD.

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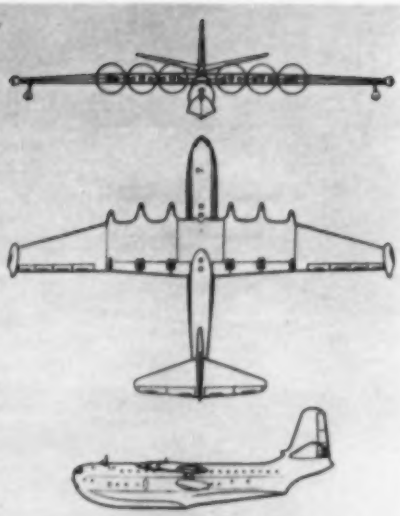
Princess That all three of the Princess long-range transport flying boats have been cocooned (two at Calshot and one at Cowes) in no way lessens the constructors' faith in the future of these magnificent machines. They must, however, await suitable power plants. The Princess was designed to be engined with Bristol Proteus 3 turboprops, arranged as four coupled units with two single units in the outboard positions. A set of under-rated and experimental versions of the Proteus 3 was provided for the development flight-test programme which was carried through with the first aircraft between August 1952 and April 1954. The Proteus 3, however, is no longer to be made available and design investigations into the possibility of fitting other power plants, at present under development, have shown that several types are suitable, among them the two-spool Bristol B.E.25. With six of these, each delivering 4,000 s.h.p. at sea level plus 2,720 lb thrust (5,045 e.h.p.), the Princess should unstick in 2,240 yd at a gross weight of 345,000 lb. Cruising speed, with 130 or 220 passengers would be 311 kt, and the still-air range in the respective cases would be 5,250 nautical miles and 4,630 nautical miles.

Skeeter The latest development of the Skeeter light helicopter is the Mk 6, with the D.H. Gipsy Major 200 engine. It is a derivative of the Mk 2, which first flew in October 1949, with a Gipsy Major of 145 h.p. The following marks 3B and 4 were intended for military use and were fitted with the 180 h.p. Blackburn Cirrus Bombardier 702. Though externally similar to the Mk 2, they incorporated considerable re-design. The Mk 5 civil machine, from which the Mk 6 is a direct development, again used the Bombardier 702, but incorporated many design improvements, resulting from experience on the previous machines, and was, of course, adapted to carry different equipment and afford improved accommodation. In the Skeeter 6, the crew of two sit side-by-side, and have an excellent field of view. Full dual controls are available, permitting the machine to be used as a trainer, but the seats are individually removable and a long-range tank may be installed in place of the seat normally used by the observer. If required, this seat can be reversed and rearward vision is satisfactory for A.O.P. work. The engine is installed transversely, the drive from the main motor being taken from the rear end of the crankshaft on the starboard side. Fan cooling is provided through a starboard intake. Each of the three main rotor blades consist of a wooden secondary structure bonded to a steel tubular spar, the whole being covered with fabric; the leading edge has plywood covering.



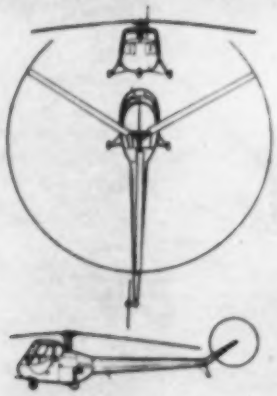
Span	210ft 6in
Length	148ft

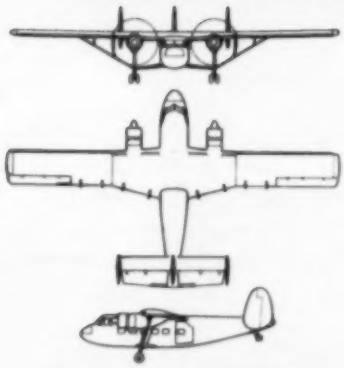
(N.B. Original version, with Proteus engines, is shown.)

Above, Princess

Below, Skeeter Mk 6

Power plant	D.H. Gipsy Major 200
Rotor diameter	32ft
Length (blades folded) ...	28ft 5in
Gross weight	2,150 lb
Max. speed	106 m.p.h.





Power plant ...	Two Alvis Leonides 503/8
Span	76ft 6in
Length	45ft 3in
Gross weight	13,500 lb
Cruising speed (40 per cent)	124 m.p.h.

Above, Twin Pioneer

SCOTTISH AVIATION, LTD.

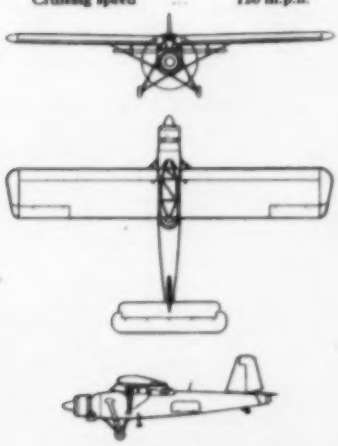
Prestwick Airport, Ayrshire
Telephone: Prestwick 79888

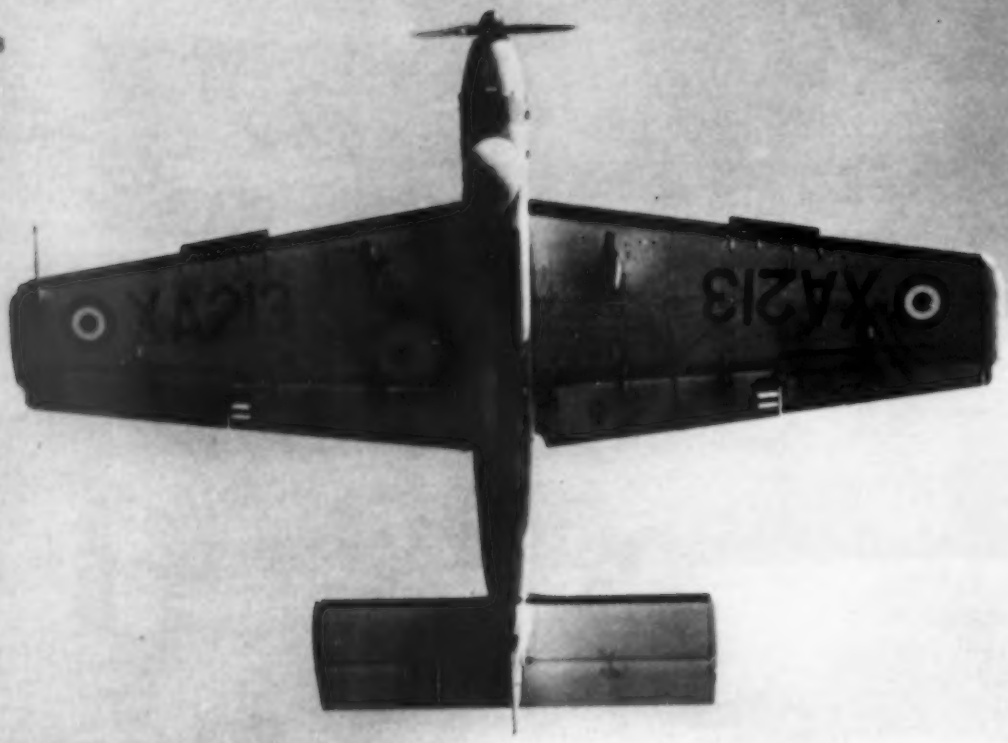
Twin Pioneer The prototype of this unique transport aircraft was built in production jigs, and tooling is now in progress for a production run of 200 machines. A "big brother" to the Pioneer, the "Twin" incorporates outer-wing panels and power units almost identical with those of the single-engined machine. It has, however, a much roomier fuselage and can carry up to 16 passengers, or well over a ton of freight, while retaining a short-field performance almost as remarkable as that of the smaller aircraft. The airframe is a simple stressed-skin light-alloy structure built up from sheet strip and plate without the use of a stretch-press. The centre section of the wing has a large built-in slot on each side of the engine nacelles, and the outer wings have very large powered slats similar to those of the Pioneer, except for the use of a single spar instead of two. The slats are opened and shut by a hydraulic jack which, through a system of chains, rotates a series of universally jointed torque tubes carried ahead of the false spar in the leading edge. The slats are mounted on tracks running between guide rollers in the leading edge; the lower edge of each track carries an integral row of teeth meshing with a chain which passes over the sprockets on the driving torque tubes. When the flaps are extended to 12 deg, the slats are opened. As is usual in fixed-wing aircraft capable of flying at low speeds, the Twin Pioneer has a large tail with triple fin-and-rudder assemblies. Especially notable is the degree of interchangeability achieved—for example, the power units, fins and rudders, slats, outer flaps, main undercarriage assemblies, nacelles, oil and outer-fuel tanks are all interchangeable. The design offers considerable promise in development for specific duties, such as the carriage of heavy freight, photographic survey, or as a carrier-borne picket or transport. A projected freight version with large rear-loading doors was represented by a model at the previous S.B.A.C. display.

Prestwick Pioneer As supplied to the R.A.F. for use on ambulance/communications duties in Malaya, the Pioneer C.C.1 has an Alvis Leonides engine, though other units can be installed without difficulty. The machine is famous for its take-off and landing abilities, achieved with the aid of full-span slats and Fowler-type flaps, operated by a single control. For a normal take-off or landing run, a 50-yd surface is sufficient, and the distance required to clear a 50-ft obstacle is only 180 yd. The Leonides-powered machine carries a pilot plus four passengers and baggage over a distance of 400 miles at 120 m.p.h. Trials have lately been under way with a special ambulance version for the R.A.F., embodying a stretcher-loading hatch.

Below, Prestwick Pioneer

Power plant ...	Alvis Leonides 504/1
Span	49ft 9in
Length	34ft 6in
Gross weight	5,400 lb
Cruising speed ...	120 m.p.h.



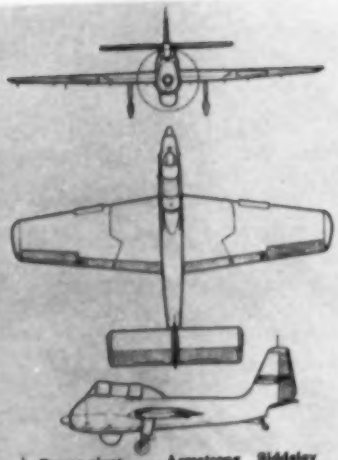


SHORT BROTHERS AND HARLAND, LTD.

Queens Island, Belfast, N. Ireland
Telephone: Belfast 58444

Seamew It is expected that a formation of Seamews—possibly five in number—will take the air at Farnborough next week. The type is well advanced in quantity production, not only for the Fleet Air Arm of the Royal Navy, but for the R.A.F.'s Coastal Command, and several other countries are taking an active interest. A prototype recently underwent deck trials aboard H.M.S. *Bulwark*.

Basically a light carrier-borne anti-submarine aircraft, the Seamew also possesses capabilities for a wide variety of other duties, including inshore reconnaissance and coastal defence, communications, air survey, observation, and tribal control. With minor modifications, including the fitting of over-sized tyres to operate at reduced pressure, the type can operate from small, crudely prepared airfields. A structural description of the Seamew is not yet allowed, but it is known that the structure weight is extremely low, and that further weight has been saved by the fitting of a fixed undercarriage. The power plant, too—an Armstrong Siddeley Mambe—is a light-weight unit, and these considerations, coupled with the large wing area, enable the Seamew to carry relatively heavy military loads. Typical combinations are: (1) one "store" (possibly a homing torpedo) in the bomb bay, together with four sonobuoys and four rocket projectiles and eight marine markers under the wings; (2) ten sonobuoys in the bomb bay and six rockets and eight markers under the wings; (3) two depth charges and five sonobuoys in the bomb bay, and four rockets and eight markers under the wings; (4) two depth charges in the bomb bay and six rockets under the wings; (5) four depth charges in the bomb bay and six rockets and eight markers under the wings; (6) 20 sonobuoys in the bomb bay and six



Power plant ...	Armstrong	Siddeley Mambe
Span		55ft
Length		41ft

Above, Seamew, A.S.1
Below, Sherpa

Below, Sherpa

Below, S.B.S

Power plant ...	Turbomeca Palas
Span	38ft
Length	31ft 10½in
Gross weight ...	3,125 lb

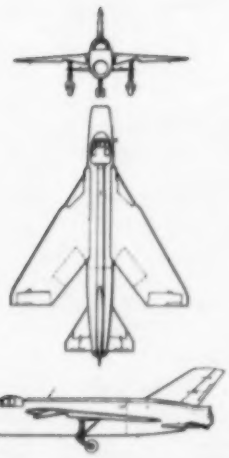
Right, Gyron-Sperrin

rockets under the wing. No gun armament is carried. The crew numbers two—pilot and navigator—and the high position of the cockpits gives an exceptionally fine field of view for patrol and deck flying.

Sherpa The Sherpa was the first aircraft in the world to have an aero-isoclinic wing—was, in fact, constructed solely with the object of determining the characteristics of such a wing. The principle of the wing is that instead of being as stiff as possible in order to overcome aeroelastic problems, it is designed to be relatively flexible, though to distort in an advantageous manner. The Sherpa made its first flight in October 1953, and is still undergoing tests at Belfast. The power plant is two Turboméca Palas turbojets, with a dorsal intake.

S.B.5 Another unique research aircraft, the S.B.5 has wings with adjustable sweepback. A flight-test programme has been laid down with four prescribed configurations: 50 deg wing sweep and high-set tailplane; 60 deg sweep and high tailplane; 60 deg sweep and low tailplane; and 69 deg sweep and high tailplane. Up to the present, the angle of sweep has not exceeded 60 deg, but the full 69 deg configuration should be undergoing trials during the next month or so, either from the R.A.E. or from Boscombe Down. As already remarked, the S.B.5 was a research vehicle for the supersonic English Electric P.1. At Farnborough on the occasion of the recent Royal Aircraft Establishment Golden Jubilee celebrations, the S.B.5 appeared with a variety of test equipment, including an under-wing instrumentation canister used for aileron and rudder-power testing.

Sperrin Since the Sperrin four-jet high-altitude bomber was first flown in 1951, machines of the type have been engaged on various forms of research for the Ministry of Supply. The most recent development is the installation of one of the new ultra-powerful de Havilland Gyron turbojets in the lower port nacelle, and at Farnborough the Gyron-Sperrin will be flying under the de Havilland banner. With the new power plant the machine first flew only a few weeks ago, and even on the initial flight the Gyron was opened up to its full flight-approved thrust. Later in the year, a second Gyron is to be fitted in the lower starboard nacelle. The Sperrin has also been used for special bombing tests, and at Farnborough recently a machine of the type was displayed with a 10,000 lb folding-fin bomb and a group of smaller bombs.



Power plant ...	Rolls-Royce Derwent
Span ...	30ft 6in (60 deg sweep)
Length	45ft 9in

Above, S.B.5
Below and right, S.K.1

SOMERS-KENDALL AIRCRAFT, LTD. *Woodley Aerodrome, Nr. Reading, Berks.*

S.K.1 Though designed primarily for racing, this tiny two-seater, powered by a Turboméca Palas turbojet, might also be suitable for certain types of training. Aerodynamic design is remarkably clean, and unorthodox features are the "butterfly" tail, retractable bicycle-type undercarriage, with wing-tip outriggers, and the mounting of the turbojet above the fuselage. Covering the cockpits is a one-piece Perspex moulding, jettisonable and hinged to starboard. The air intakes are in the form of two scoops, each with a boundary layer by-pass. Undercarriage retraction is effected by compressor-bleed air working in rams at a pressure of about 30 lb/sq in. The wheels are extended by gravity and springs, with manual assistance. Take-off distance, to clear 50ft, is estimated to be about 760 yd, and landing run, from 50ft, 480 yd. The shoulder-mounted wing has a single three-ply box spar, built as a single unit and, with a view to preserving laminar flow, the spar in the outboard half of each panel is not in contact with the skin. The inboard sections of the wings have no ribs. They are made up of a curved ply and balsa sandwich over ¼in thick, and house the fuel supply of up to 50 gallons. The ailerons run full span, and dive brakes are fitted on upper and lower wing surfaces. Flying at its maximum all-up weight of 1,500 lb, the S.K.1 should have a stalling speed of about 73 m.p.h.

Power plant ...	Turboméca Palas
Span	... 22ft 9in
Length ...	... 20ft 10in
Gross weight	1,300 lb (aerobatic)
Max. speed ...	... 332 m.p.h.

VICKERS-ARMSTRONGS LTD. *Weybridge Works, Weybridge, Surrey*
Telephone: Byfleet 240

Viscount No British civil aircraft has brought more rewards to its makers and operators, or greater credit to its country of origin, than the Vickers-Armstrongs Viscount. At the time of writing 234 Viscounts have been ordered by airlines, governments or private operators in 17 different countries. The number already delivered is 70 and hours flown in scheduled service amount to nearly 150,000.

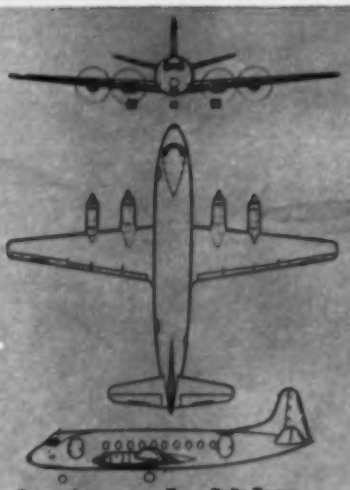
The story of the Viscount, and of its exceptionally reliable Rolls-Royce Dart turboprops, is one of constant development. The first prototype, which made its maiden flight in July 1948, weighed 40,000 lb "all-up," was powered by early Darts of 1,380 e.h.p. and accommodated 32 passengers. Current production Viscounts have a gross weight of 60,000 lb, are powered by 1,780 e.h.p. Darts and carry up to 53 passengers. Further "stretching" of the design appears certain.

European airlines now operating Viscounts are B.E.A., Aer Lingus, Air France and Hunting-Clan Air Transport. Operators abroad are Trans-Australia Airlines, Trans-Canada Air Lines and Capital Airlines—whose $67m order for 60 Viscounts was perhaps the most significant peace-time contract won by a British aircraft company. Each of these airlines in turn has reported a repetition of the trend observed immediately after B.E.A.'s introduction of Viscounts on regular service—better load factors and marked gains of traffic from competitors using piston-engined transports. In Australia, where T.A.A.'s brand-new Viscounts come into service last December, the aircraft gave so few of the customary "teething" troubles that a daily utilization of 8 hr per aircraft was achieved in the first three months of operation. Viscount passengers carried by T.A.A. in this period totalled 50,000; the first aircraft of T.C.A.'s fleet, introduced to service in April, also carried 50,000 passengers in the first three months. Canadian Viscounts have been flying with 81.5 per cent of all seats filled, compared with 72.6 per cent on other T.C.A. aircraft. On the competitive Toronto-New York run the introduction of Viscounts increased T.C.A.'s traffic by 32 per cent. Quietness, freedom from vibration, and speed have all contributed to the Viscount's extreme popularity among the air-travelling public.

The characteristics of individual Viscounts vary according to operators' requirements: the "standard" Viscount does not exist. A typical example of the new "700D" series, however, is the V.745, now in production for Capital Airlines, which is laid out to carry 40-48 passengers in four-abreast seating and is manned by an operating crew of two pilots only. Standard power-unit of the V.745 will be the Dart 510, which delivers 1,780 e.h.p. at take-off and gives both higher cruising power and better fuel economy than the 1,547 e.h.p. Dart 506s fitted in the first few Capital aircraft. The internal fuel tankage of 1,916 gal (compared with 1,720 gal in B.E.A. and other European Viscounts) can be supplemented by two wing-mounted "slipper" tanks containing 145 gal each. Drag penalty of these tanks is slight, reducing the V.745's cruising speed of 320 m.p.h. by only 4-5 m.p.h.

The next major stage in the Viscount development story will be the delivery next year of the first V.800, a long-bodied version designed to B.E.A. specification and also adopted by K.L.M. and Transair. A 46in fuselage "stretch," coupled with a 65in aft movement of the rear pressure-bulkhead, enables the V.800 to carry up to 70 passengers, B.E.A. quote the following comparative payload-range speed figures for their two versions of the Viscount: V.701A, 950 miles at 318 m.p.h. with 11,808 lb payload plus full fuel reserves; V.802 "Viscount-Major," 540 miles at 315 m.p.h. with 12,826 lb payload plus full reserves. It will be seen that the enlarged Viscount is intended primarily for service on the shorter high-density routes; on these sectors, in fact, it is expected to reduce operating costs by some 20 per cent.

Most Viscounts are built at Hurn. The present production rate of five aircraft monthly will

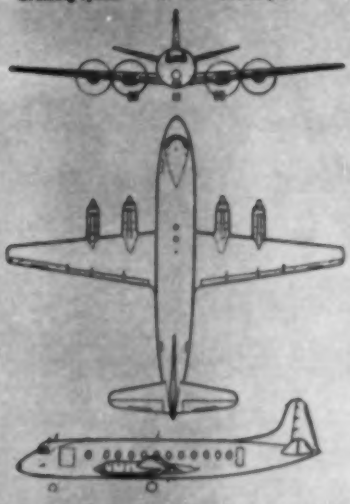


Power plant ...	Four Rolls-Royce Dart 510
Span	93ft 8½in
Length	81ft 2in
Gross weight ...	60,000 lb
Cruising speed ...	320 m.p.h.

Above, Viscount 700D

Below, Viscount 800

Power plant ...	Four Rolls-Royce Dart 510
Span	93ft 8½in
Length	85ft
Gross weight ...	62,000 lb
Cruising speed ...	315 m.p.h.



Above, V.1000

increase to six next year and—if the order-book warrants it—to ten monthly in 1957. A smaller production line is also being set up at Weybridge.

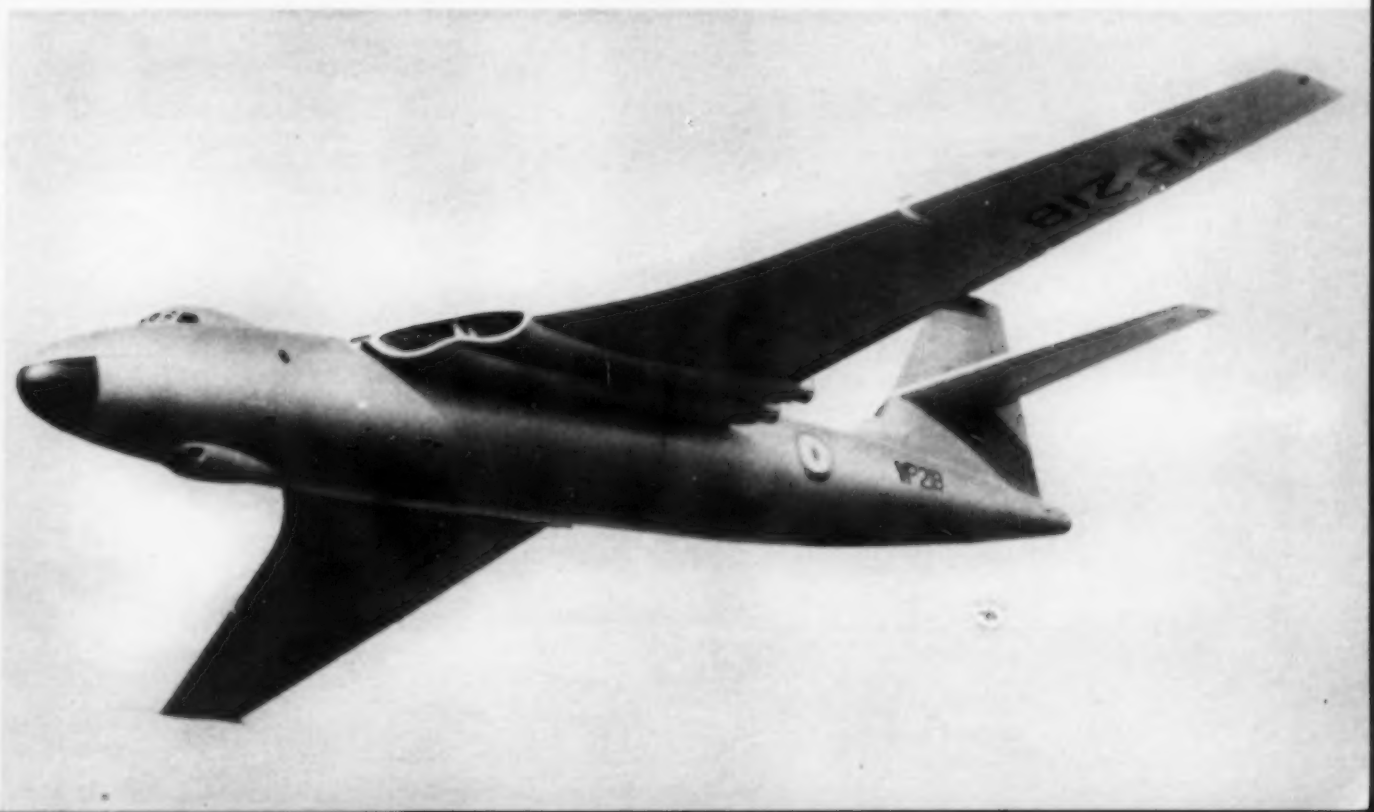
Valiant Indicative of the range potential of this V-class bomber were the planned stages for an England-New Zealand flight which, in the event, did not take place. They were: London-Karachi (4,192 miles), Karachi-Cocos Islands (3,255 miles), and Cocos Islands-Christchurch (4,929 miles). As for speed, a production Valiant recently flew to Australia, setting up two records on the way. From London to Baghdad it averaged 523 m.p.h.; from Singapore to Darwin, 518 m.p.h. For the New Zealand flight, the aircraft was to have carried auxiliary tanks in the bomb-bay, though with a full bomb load, the Valiant would be capable of operating over very great distances by virtue of flight refuelling. As now in production for the R.A.F., the Valiant is designated B.1; the B.2 was a special "one-off" development with a lengthened nose and trailing-edge fairings housing a twin-four-wheeled-bogie main undercarriage. This version is capable of remarkably high speeds at low level. The B.1 is essentially a high-level machine, and is powered with four Rolls-Royce Avon turbojets, probably each with a five-figure thrust rating. These units are housed in the inboard sections of the wing and beneath the outboard sections provision is made for large auxiliary fuel tanks. The flaps are of the double-slotted type, extending outboard almost to the ailerons. A member of *Flight* staff who was present at the departure of a production Valiant B.1 for the Woomera bomb-ballistics range wrote recently: "Both pilots have the Martin-Baker Mk 3 ejector seat and wear the leg-restraint garters associated with this equipment. None of the crew appeared to wear pressure-breathing waistcoats, but the new British pressure-demand mask was in evidence. The other crew members (four on this occasion, though there are normally three) wore the new ankle-length boots, Mae Wests and a new type of back-type parachute with quick-adjusting harness straps and barometric release capsule in addition to the normal rip-cord. They sit side-by-side in rearward-facing seats . . ."

Production Valiants, lightly loaded, have taken off in under 600 yards.

V.1000 Designed as a military transport capable of carrying 120 troops with full equipment, the V.1000 is a larger aircraft than the Valiant and has four Rolls-Royce Conway by-pass turbojets. A production order has been placed on behalf of the R.A.F., and a civil version could carry 90 passengers, first-class, from Paris to New York. A military prototype is well advanced.

Below, Valiant B.1

Power plant	Four Rolls-Royce Avon
Span	114ft 4in
Length	108ft



VICKERS-SUPERMARINE

Hursley Park, Winchester, Hants.
Telephone: Chandlers Ford 2251

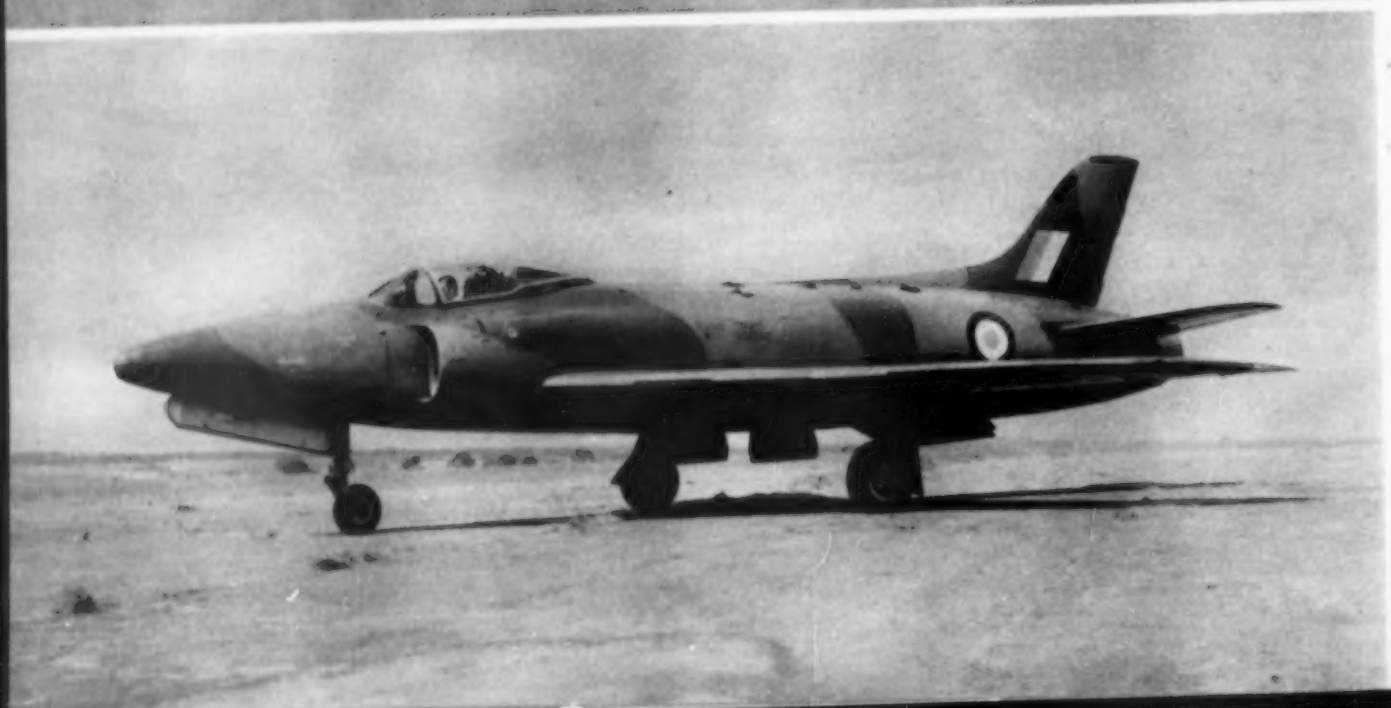
N.113 and Type 525 Now in full production for the Fleet Air Arm, and primarily intended as a supersonic fighter, the N.113 will also be capable of carrying an atomic bomb. It is powered with two Rolls-Royce Avon turbojets, and has been developed from two experimental machines, the Type 508 and Type 525. The 508 had a "butterfly" tail and a straight wing. On the Type 525, the wings were swept back and the tail was a conventional assembly with swept surfaces. It was recently disclosed that the Type 525 had been fitted with a "supercirculation" system, the first application of its kind to a British military aircraft. In this system compressor-bled air is blown over the upper surface of the flaps when these are extended, thus preventing the break-away of the airflow which normally occurs over the flaps during a landing approach, causing loss of lift. The extra lift gained by the system not only reduces landing speed, but offers other advantages. For instance, it provides a flatter approach attitude, and consequently a better view for the pilot. Additionally, it allows him to vary the total lift of the wing by adjusting the engine power-setting. While armament of the N.113 may not be disclosed, provision was made on its precursors for four 30 mm guns in the bottom of the power plant housings. During the course of development the wing was modified to have a "saw-tooth" leading edge, as on the Swift.

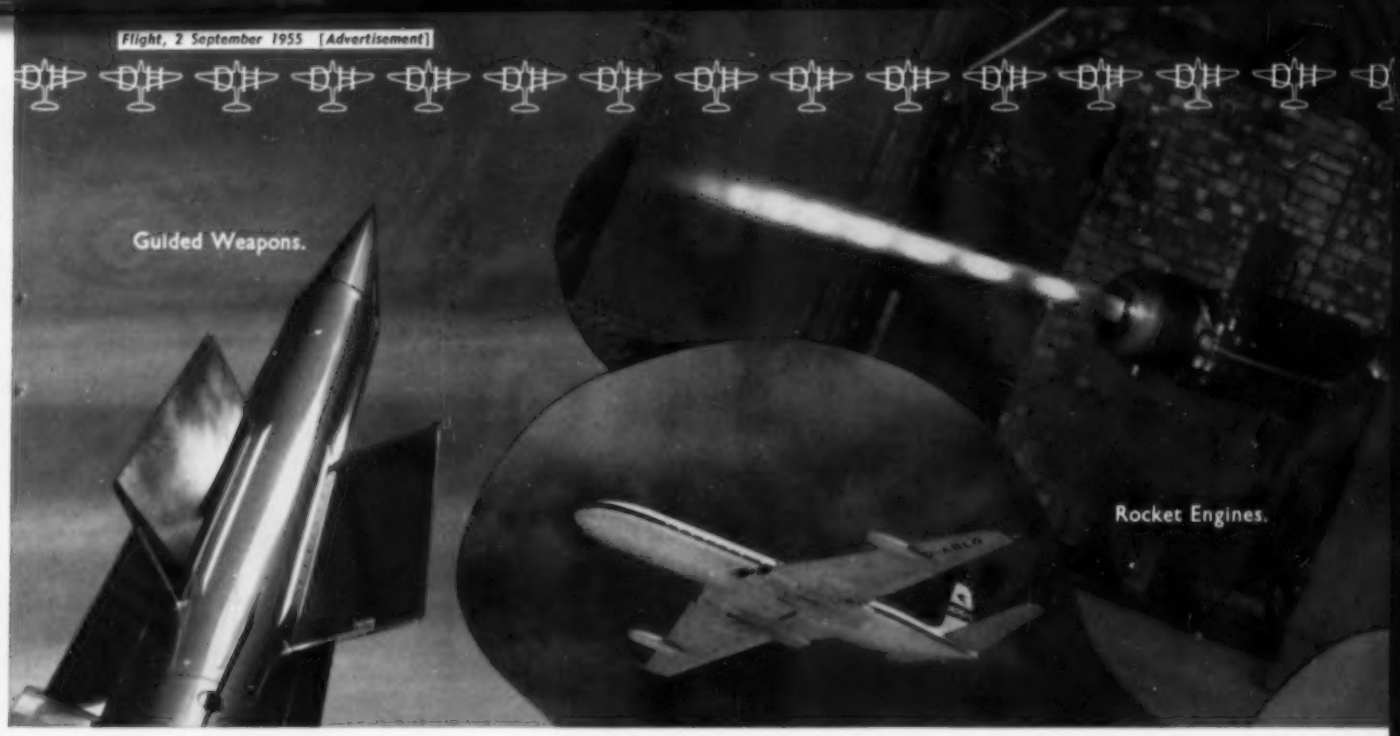
Swift In its F.R.5 form the Swift is now in full production for the R.A.F. in Supermarine factories at Eastleigh, Itchen and South Marston. It is equipped for fighter/reconnaissance duties, and has three cameras mounted obliquely in the very long re-designed nose. Built-in armament is two 30 mm Aden guns, and provision is made for "a variety of externally-mounted weapons." Although these may not at present be specified, it is not inappropriate to recall that at the previous S.B.A.C. display, a Swift F.4 was exhibited with a 1,000-lb streamlined bomb under one wing, and eight 60-lb rockets under the other. It was noted that a variable-incidence tailplane was fitted, and that internal fuel capacity was no less than 778 gallons—500 gallons in the rear fuselage, 98 gallons behind the cockpit, and 90 gallons in each wing root. Furthermore, the F.R.5 is known to be able to carry a 220-gallon jettisonable tank beneath the fuselage. The Rolls-Royce Avon engine of the F.R.5 is fitted with an afterburner, which will provide fast acceleration after, or during, reconnaissance of dangerous areas. The production version of the F.R.5 differs from earlier Swifts in having a clear view canopy, and a "saw-tooth" leading-edge.

Power plant ... Two Rolls-Royce Avons
No data available

Above, Type 525
Below, Swift F.R.5

Power plant ...	Rolls-Royce Avon
Span	32ft 4in
Length	42ft 3in





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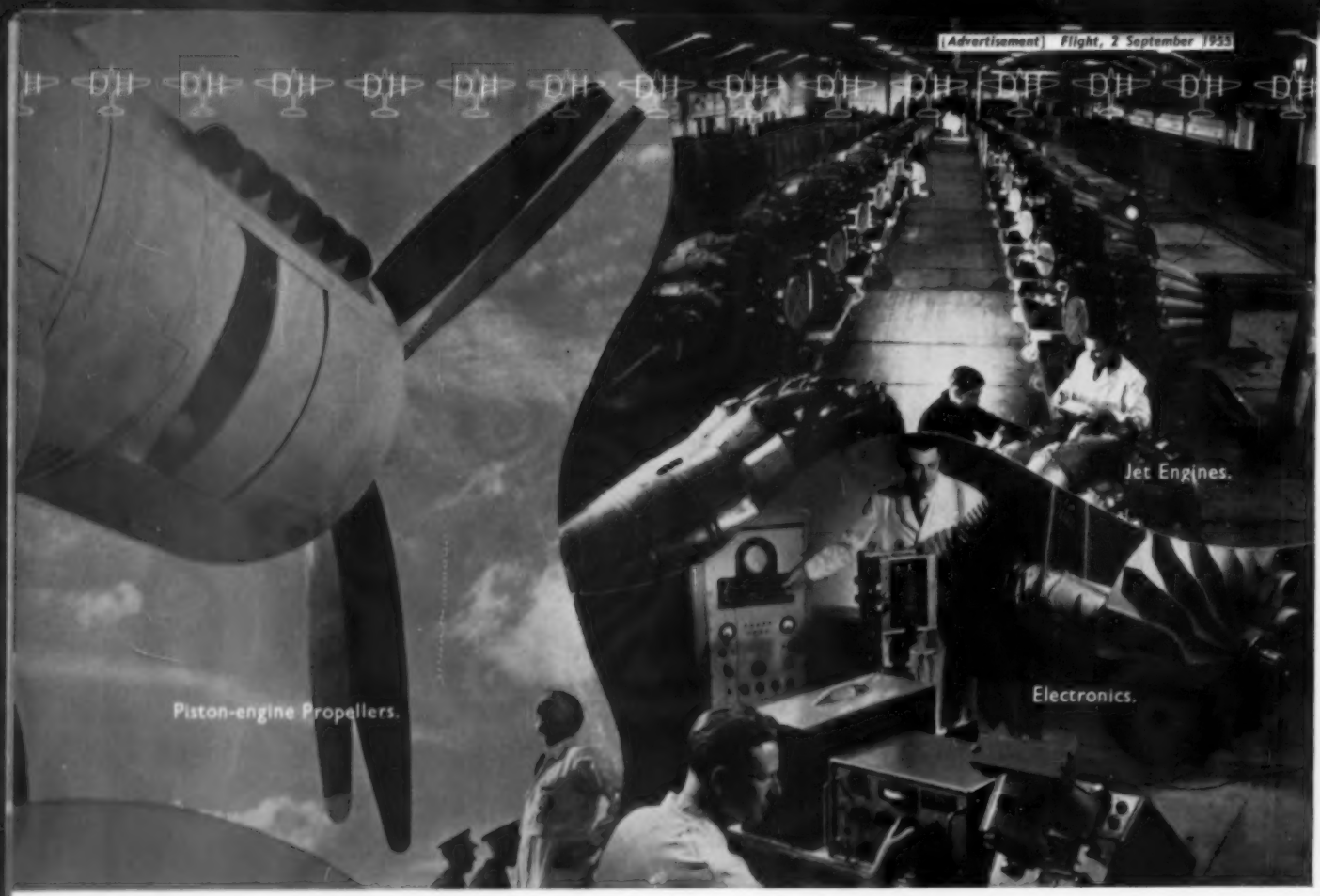

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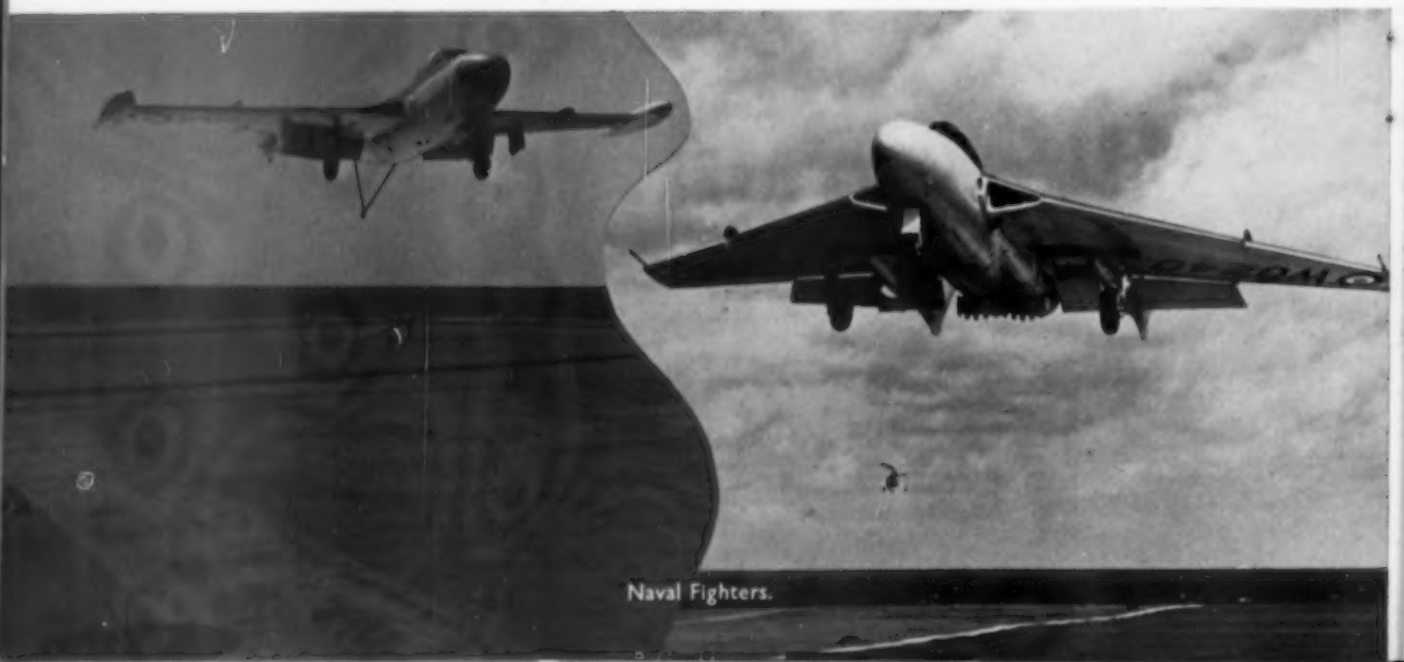

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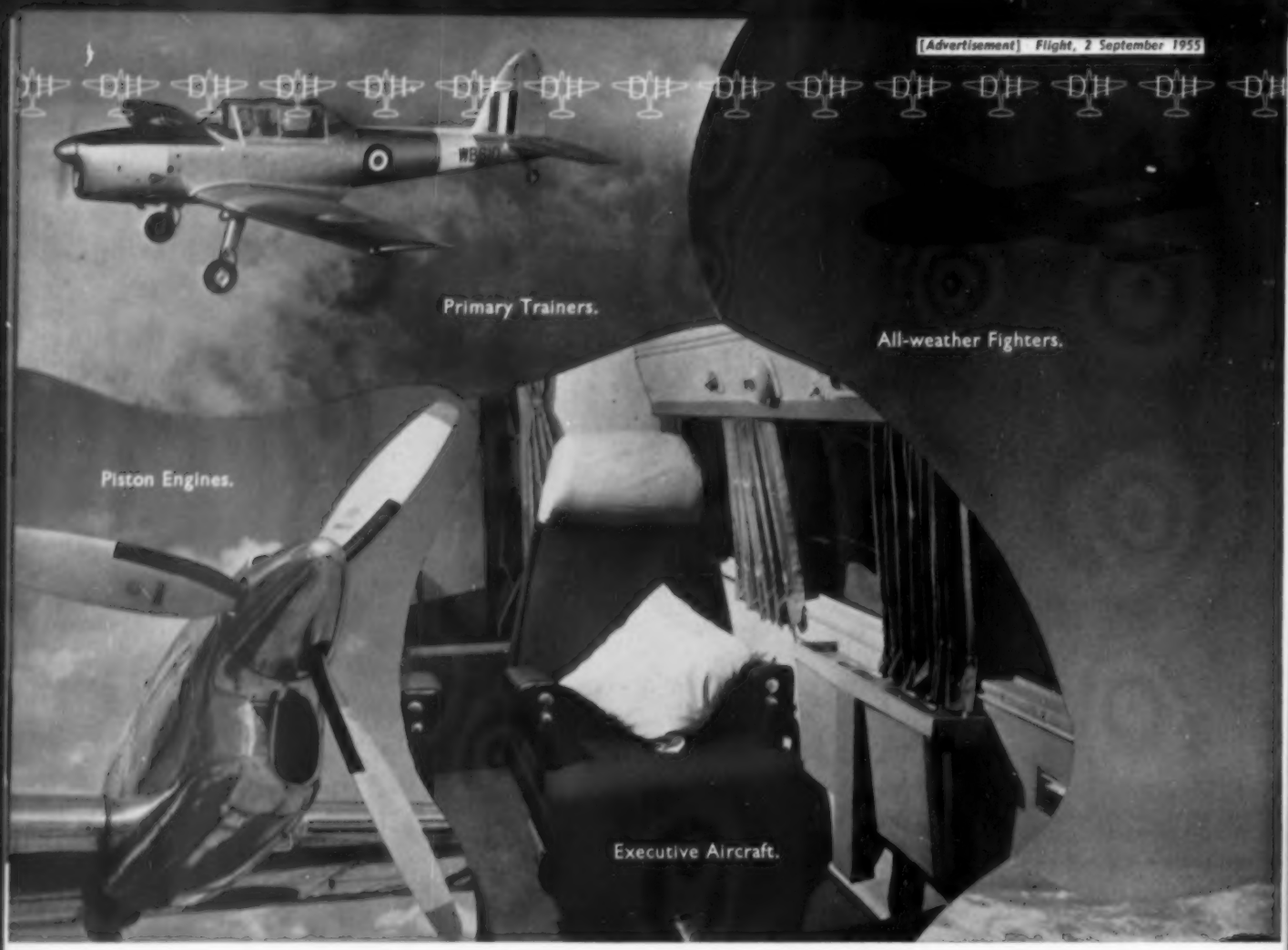

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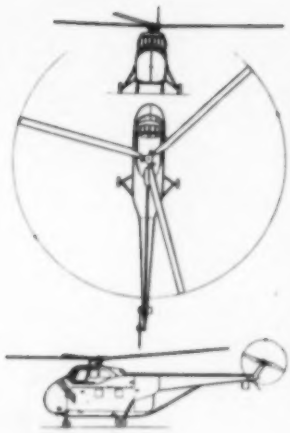


Above, S-55 (Whirlwind)

Power plant ...	Pratt & Whitney Wasp R-1340
Rotor diam.	58ft
Fuselage length ...	41ft 8½in
Gross weight ...	7,500 lb
Cruising speed ...	90 m.p.h.

Widgeon In this year's S.B.A.C. display it is proposed to introduce a new development of the S-51 series of helicopters known as the Widgeon. Principally it differs from the S-51 in having a completely re-designed nose and cabin. Like the S-51, however, it has the Alvis Leonides engine, though the rotor head is that of the S-55, which should confer greater stability and performance. All-up weight has been increased by 200 lb to 5,900 lb. Three versions of the Widgeon will be available. The first will be a passenger machine with accommodation for a pilot and four passengers, one passenger being alongside the pilot, and the other three behind in individual seats (not a bench-type seat as at present used in the S-51). The second variant will be an ambulance to carry two stretcher cases, one above the other, and a seat will be provided for a medical attendant behind the pilot. The stretchers will be taken aboard through clam-shell doors, similar to those which give access to the engine in the S-55, a feature which will do away with the necessity for using external panniers, as in the past. The third version will be for rescue work, and will have a winch mounted on the starboard side, so that the pilot will be able to operate it himself, and see exactly what is going on, rather than depending upon a crewman as is necessary when the S-51 is used for rescue work. (On the S-51 the winch is positioned on the port side.)

S-55 The newest version of the S-55 Whirlwind to be built for the Royal Navy is the Mk 5, with Alvis Leonides Major engine instead of the Pratt and Whitney Wasp or Wright Cyclone as in earlier machines. It is the intention of Westland Aircraft to standardize the Alvis power plant in the future, although the Wasp will still be available for those who desire it. The earlier versions of the Whirlwind are distinguished as follows: HAR.1, a development for the Royal Navy with Pratt and Whitney Wasp R-1340-40 engine, having an empty weight of 5,286 lb, a gross weight of 7,500 lb, a top speed of 110 m.p.h., and a range of 290 miles. HAR.2: similar to the HAR.1, but built for the R.A.F. and scheduled to operate with Coastal and Transport Command. HAR.3: a development for the Royal Navy having the Wright Cyclone R-1300-3 engine. HAR.4: powered with a Pratt and Whitney R-1340-57 engine with a 12:1 blower ratio, whereas the R-1340-40 has a 10:1 ratio. The HAR.4 is built for the R.A.F. and is operated in the Far East. For the Ministry of Supply a number of

Below, S-51

Whirlwinds have been adapted for special tests and duties, including anti-submarine work and minesweeping. A notable, and popular, feature of the Whirlwind is the mounting of the engine and accessories in the nose rather than on the centre of gravity as in the S-51. Access is gained through two doors which fold back on vertical hinges. The dual-control cockpit is located high up above, and slightly behind, the engine. For the B.E.A. service between London's South Bank and London Airport, S-55s have been equipped with floats.

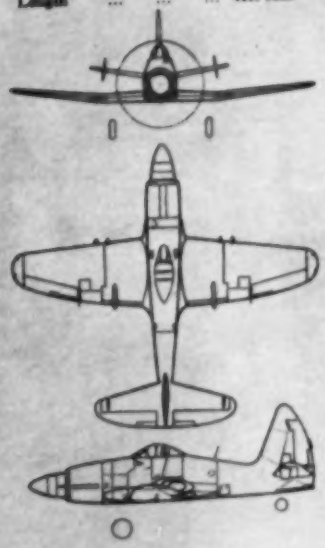
S-51 Two basic versions of the S-51 (or Dragonfly, as it is known to the British Services) are built at Yeovil. The Series A has the Alvis Leonides engine, and the Series B the Pratt and Whitney Wasp Junior. British Service variants are the HAR.1, for the Royal Navy, having composite main-rotor blades, Leonides Mk 50 engine and equipment for air/sea-rescue and special photographic duties; the HAR.3, a Naval variant with all-metal main rotors and hydraulical servo control; the HC.2 casualty-evacuation aircraft for the R.A.F., with Leonides Mk 50 engine, and capable of carrying two stretcher cases in panniers on the fuselage sides; and the HC.4, an R.A.F. version similarly powered and having all-metal main-rotor blades and hydraulic servo control.

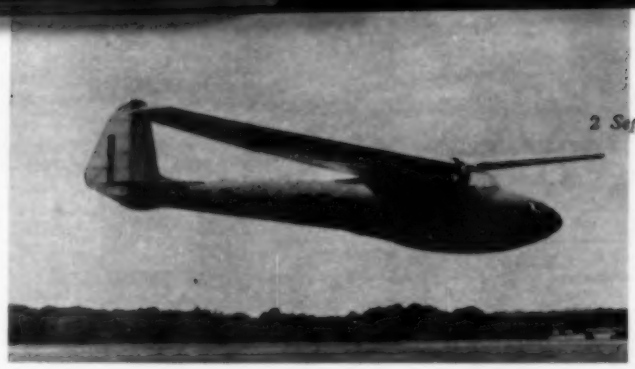
Wyvern The Wyvern is the standard carrier-borne strike aircraft of the Royal Navy, and is the only turboprop machine of its class in service. The engine is the Armstrong Siddeley Python, driving a contra-rotating Rotol airscrew. In addition to four wing-mounted 20 mm guns, bombs, rockets, depth charges or mines can be carried beneath the wings. A typical load might be a torpedo, or a 2,000-lb bomb or eight 60-lb R.P.s. Features include hydraulically operated Youngman lift flaps, air brake flaps on the inner wings, and a wide-track, long stroke undercarriage. Although the cockpit is positioned fairly far aft, the pilot's view for deck-landing is good, by reason of the fact that the fuselage nose slopes sharply down ahead of the cockpit.

Jet-Deflection Meteor A notable Westland development of the past year was the adaptation of a Gloster Meteor to take jet-deflection units, working in conjunction with Rolls-Royce Nene turbojets. Advantages to be gained from jet-deflection are: (1) an aircraft can take off and land using shorter runways than hitherto; (2) the speed range can be substantially improved; (3) it is possible to produce an aircraft of smaller dimensions for a given all-up weight (saving structure weight, cost and raw materials); (4) for the pilot, it is easier to carry out an approach without changes of airspeed or attitude; (5) rate of descent can be quickly checked, or converted to climb, with little tendency to increase forward speed. The deflection boxes themselves were designed and constructed at the National Gas Turbine Establishment at Farnborough. At the R.A.E. Golden Jubilee celebrations earlier this year, the machine gave a thoroughly convincing demonstration of its slow-landing capabilities.

Below, Wyvern S.4

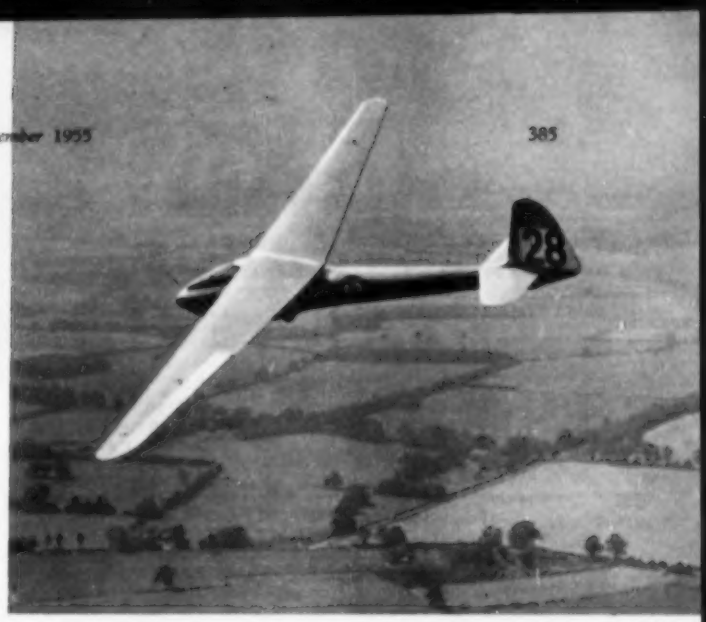
Power plant ...	Armstrong	Siddeley Python
Span	...	44ft
Length	...	41ft 10in





Eon Olympia IV

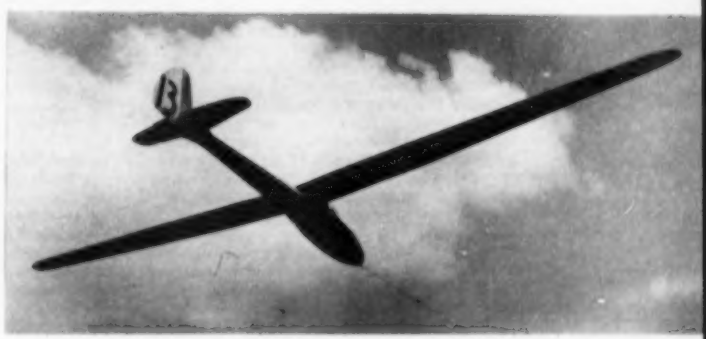
Eon Olympia II (modified)



SAILPLANES and GLIDERS

THIS year's National Gliding Championships at Lasham introduced several newcomers to the British gliding scene. Brand new were the eighteen-metre Skylark III, with 20:1 aspect ratio, and Elliotts' modified Olympia II with faired cockpit canopy. Competing in championships for the first time were six Skylark IIs, representing the new generation of club and syndicate-owned single-seaters. And, following appearances at the World Championships at Great Hucklow last year, the Olympia IV and the T.42 two-seater were still new enough for their performance to be studied with interest. And yet it was a Sky, several years old now, which won the Lasham championship. Almost inevitably, it was flown by Philip Wills—the man who, in becoming World Champion in 1952, brought British sailplanes and the Sky in particular to the notice of the world, and paved the way to the outstanding export successes of British sailplanes and gliders since then.

The two main manufacturers of British sailplanes are **Slingsby Sailplanes, Ltd.**, Ings Lane, Kirbymoorside, Yorkshire (Kirbymoorside 312) and **Elliotts of Newbury, Ltd.**, Albert Works, Newbury, Berks (Newbury 312). Some of their current products are illustrated on this page.



Slingsby Sky

Slingsby Skylark II

Slingsby T.42 "Eagle"

Slingsby Skylark III

MISSILES and TARGETS

An R.T.V.2 exhibited at Farnborough earlier this year. Designed largely by the R.A.E., this vehicle was displayed sectioned, but without boosters, at the last S.B.A.C. show.

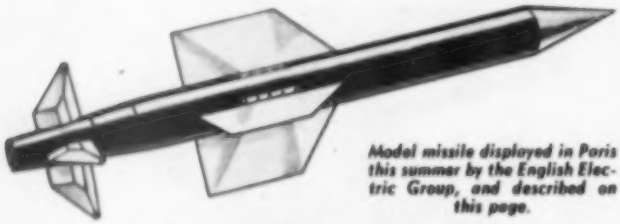
BRITAIN'S guided-weapon programme, although carefully cloaked in the veils of a well-planned system of security, is gradually taking more coherent form. A considerable amount of development was revealed for the first time at the recent Golden Jubilee of the R.A.E., Farnborough, and there are indications that many other lines of development, previously secret, will gradually be released for publication.

Two model missiles were exhibited by the English Electric Group—English Electric, Napier and Marconi—at the Paris *Salon* earlier this summer. In reporting this exhibit, we wrote:

"The geometry of this design strongly resembles that of a missile of which a photograph was released last year—an action shot showing a ground-launched vehicle being fired, with eight boosters dropping away in pairs from between the wings. On the black-and-silver models, however, no provision for boosters could be seen. The body has a parallel section for most of its length, with a conical (not ogive) nose and a boat-tail. The main wings and tail control surfaces are all of parallel double-wedge section, and the artist has indicated the section by shading. One puzzling fact is that, whereas the wings are generally raked backwards, the mean-chord of the controls is raked forward.

"The thickness-chord ratio of the wings seems to be less than five per cent whereas that of the control surfaces is at least 12 per cent. Both wing and tail surfaces are in the same angular positions on the body (unlike a de Havilland model exhibited at the last S.B.A.C. show) and the control system is obviously of the cruciform type instead of the roll-and-steer variety which is finding favour in some American missiles, such as Bomarc.

"The English Electric team, including as it does the Napier (propulsion) and Marconi (guidance) companies, are the only organization in the world capable of effecting a complete missile system unaided. Although nothing can yet be said of any of their work, the mere appearance of these neat little models is worth recording."



Model missile displayed in Paris this summer by the English Electric Group, and described on this page.

Another company which has not previously shown actual evidence of their work in this field are Short Brothers and Harland, Ltd. At the above-mentioned R.A.E. Jubilee show, Shorts exhibited a G.P.V. (general-purpose vehicle), for which a radar homing head was contributed by the joint efforts of the R.A.E. and Elliott Brothers (London), Ltd. Also in evidence at Farnborough on this occasion were a number of the ubiquitous R.T.V.s (rocket test vehicles), an example of which was illustrated in our last issue in the account of the work of the Long-Range Weapons Establishment at Woomera.

Of the R.T.V.s shown at Farnborough, one had actually been fired on the Aberporth range on June 7th and recovered from the sea complete. The spherical flotation bag and triple G.Q. drag chutes were deployed; and a complete set of photographs showing drag and recovery parachute development, filmed in flight from inside the missile itself, was laid out nearby. This particular R.T.V.2 carried a gyro-stabilized radar search aerial behind a sharply pointed plastic nose cone. Several of these gyro-controlled aerials were to be seen in various parts of the Establishment, one of them locked by a pencil-beam of light on to a photo-electric cell. R.T.V.1, made by Marston Excelsior and Armstrong Whitworth Aircraft, Ltd., had a rocket motor using lox and water/alcohol giving 1,075 lb thrust for 21 sec, with a consumption of 6.2 lb/sec. The vehicle weighed 260 lb all-up and the tanks were pressurized by a solid charge.

Missile flight is controlled by cruciform fin systems rotated either together as elevators and rudders or, differentially, as ailerons. Here either hydraulic or pneumatic power is used. A brief review of just a few of the items on show in the many laboratories dealing with guided weapons serves to give an idea of the wideness of the field and of the work being done. Included were Command Link Guidance systems for a C.T.V.1, quartz crystal stabilized centimetric oscillator, curved followers, a spectral density analyzer, optical demonstration and beam riding, conical scan and static split aerial systems, and an apparatus enabling a pilot to fly accurately within a radar beam. Micro-wave research was demonstrated by radio-Doppler effect exhibits, measurement of dielectric properties, micro-wave aerials and friction-controlled gyroscopes. Many of these devices and systems are tested by a variety of simulators. It is noteworthy, however, that none of the vehicles or equipment exhibited referred to anything more than beam-riding and semi-active (homing on radar reflections) interception techniques.

Of targets, it can now be seen that lightweight turbojets are making possible the design of efficient, highly elusive targets, carrying radar transponders at sonic speed, the destruction of which represents no unbearable burden on the Exchequer. At the last S.B.A.C. exhibition such companies as M.L. Aviation, Ltd., displayed, albeit in model form, projects of this type.

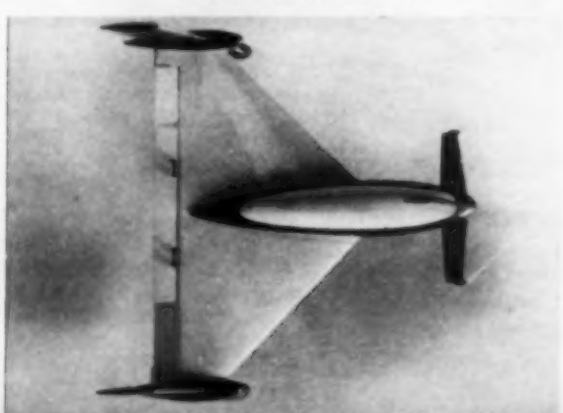
M.L. are, of course, already delivering numbers of slow-speed (200 m.p.h.) targets powered by Vincent two-stroke piston engines. Auster Aircraft are also regular suppliers of a cheap piston-engined target widely used by the British Army.

For fighter-pilot practice, towed targets are employed. The increasing speed of modern fighters has necessitated a corresponding improvement in the Mach-worthiness of their target aircraft, and Brooklands Aviation and Air Service Training are both delivering very satisfactory vehicles of near-sonic (Mach 0.9) capability. The former has the form of a thin, swept wing carrying a pair of vertical fins above the trailing edge. The A.S.T. company exhibited a new design of target at the Paris *salon* this year (in model form, towed by a Hunter), which is a direct development of the C.4 described on this page last year. The revised target has twin, swept fins on the cut-off tips of its true-delta wing. The towing bridle attaches to the tips of a "canard" nose plane, and a trimming surface is provided at the trailing edge of the main surface. There is also a swept nose-fin.

At the S.B.A.C. Show, the R.F.D. Co., Ltd., will have on view a new container for sleeve-targets, designed for mounting under the wing of the tug. This company's major development, however, is the Dart target, which derives its name from its resemblance to a paper dart. Cruciform wings of 4ft span are fitted and the overall length is approximately 12ft; balance weights are contained in a 4ft tube of approximately 4in diameter which projects forwards, and radar reflectors are situated at the tail end. Construction in the simplest form of Dart is plywood, with a metal backbone. The maximum weight is approximately 150 lb and, in the U.S.A., speeds of approximately 450 knots have been achieved.

Launching procedures have not yet been finalized in this country; in America snatch-launches have been employed, but R.F.D. hope to be able to start both the tug and target from rest. The original design of this target was carried out by the U.S. Navy, and R.F.D. are developing various English versions and have already delivered a small production order for the Ministry of Supply. The company, incidentally, continue to manufacture their twin-fuselage towed glider.

Plan view of a model of Air Service Training's new high-speed towed target. Carrying a radar transponder, this target can be towed at high subsonic Mach numbers.



BRITISH POWER UNITS

1955

THE past twelve months have been some of the most satisfying that the manufacturers of British aero engines have ever enjoyed. At any given time, no doubt, the horizons of our engineers have been clouded by annoying difficulties, and so it will always be. But, in retrospect, it becomes apparent that every British engine company can report solid progress since 1954.

Pride of place, this year, must be accorded to the de Havilland Engine Company, whose immense efforts during the past six years (the period which has elapsed since they last displayed a wholly new unit) seem about to be crowned by a triumphant showing of the most powerful engine in the Western world, the Gyron—and, possibly, one of our most important rocket motors, the Spectre. Each complements the other in the propulsion of highly supersonic aircraft; and in other spheres also they will provide invaluable power when airframes can be found to take them. In a very different field, the new fuel-injection Gipsy Major 200 has made its bow.

Rolls-Royce, however, are likely to be able to exhibit the Conway by-pass engine—the outcome of a truly formidable amount of back-room work—and couple it with the announcement of a type-test at the record thrust of 13,000 lb, and with a specific fuel consumption lower than that of any other type-tested turbojet. The security-shrouded R.B.109 turboprop has also passed a significant milestone during the year, and is an exceptionally promising engine.

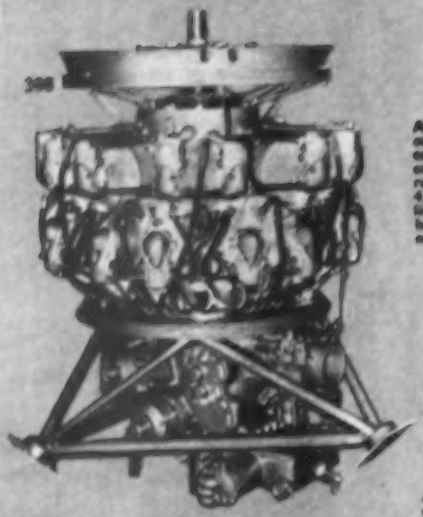
At Bristol, the medium-power Orpheus turbojet has sprung to life with unparalleled rapidity; in every respect it is an outstanding design, and it is certain to be very widely employed. Equally remarkable, although wholly dissimilar in character, is the finely engineered two-spool Olympus, which has now been type-tested at 11,000 lb thrust—a world-beating figure until the announcement of the Conway figure—and has been delivered in quantity. Bristol are maintaining their leading position in the field of high-power turboprops by receiving unrestricted approval for airline use of the Proteus; and, for the future, the main components of the very advanced B.E.25 have already been extensively tested. Bristol also hold a dominant position in the ramjet business—and with an excellent ramjet, at that—but this work remains "under wraps".

Armstrong Siddeley's progress can be summed up as follows: The Sapphire has leapt from one thrust rating to another, and the latest figures are so impressive that they cannot yet be quoted; the fearsome Screamer rocket motor has given more than its design thrust and holds immense promise; the Double Mamba has become a thoroughly "bread-and-butter" engine, and is now widely used in the Gannet, with the promise of more power yet to come; the single Mamba, in an advanced form, has gone into production, and promises to yield still further increments of output; and the Viper has roughly doubled its design thrust, and in conjunction with rocket power has achieved the distinction of supersonic speed in a climb.

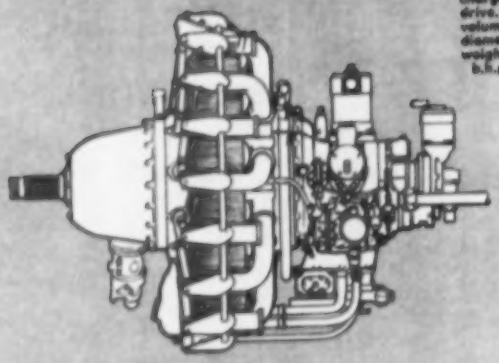
Napier's work has been the steady development of their two slim, finely designed axial engines, the Eland turboprop and the unique Oryx gas-producer. Both have progressed very satisfactorily, and they are nearing the stage where the Acton company can sell them as proven articles. The Eland, in particular, bids fair to capture a wide market, particularly in its 4,000 h.p. form, with air-cooled turbine blades. Mention—and only that—is also permitted of the Gazelle shaft-driving engine, which promises to be a real best-seller.

In Yorkshire, Blackburn are going into production with a rationalized range of small gas turbines, originally based on the Turboméca Palas. Major effort is being applied to the free-turbine Turmo, in single and coupled versions, and the Palouste gas-producer, both of which are now ready to drive helicopters or other aircraft.

The Alvis company can repeat the same story as the other firms: solid progress, particularly with the Leonides Major and with its neat petal-cowled, installation. Meanwhile, the single Leonides has been put to work even more widely around the world, in both fixed-wing aircraft and helicopters.



Alvis Leonides Major Lo.M. 1-3 helicopter engine. Fourteen-cylinder, air-cooled, poppet-valve radial, with vertical crankshaft, fan cooling and remote reduction gearbox. Bore, 4.8in; stroke, 4.41in; swept volume, 1,117 cu in (18.28 litres); overall diameter, 38.925in; total height, 54.856in; dry weight, 1,080 lb; maximum power, 870 h.p. at 3,000 r.p.m. at 9 lb boost at sea level.



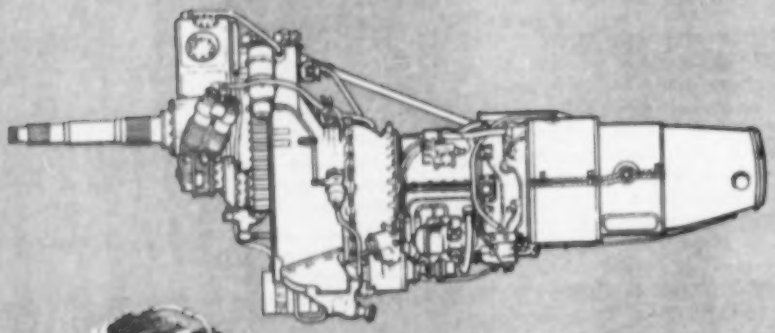
Alvis Leonides 503/8 (fixed-wing). Nine-cylinder, air-cooled, poppet-valve radial, with single-speed, single-stage supercharger, injection carburettor and geared drive. Bore, 4.8in; stroke, 4.41in; swept volume, 718.6 cu in (11.78 litres); overall diameter, 41.5in; length, 54.4in; dry weight, 798 lb; maximum power, 576 h.p. at 3,000 r.p.m. at 9 lb boost.

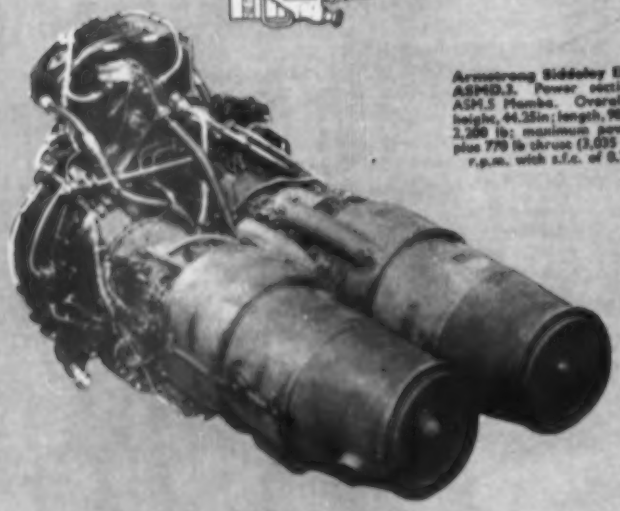
ALVIS LTD. *Coventry. Tel. Coventry 5301*

Leonides and Leonides Major. Provosts of Flying Training Command logged an impressive number of hours during the past 12 months, as did the many other fixed-wing aircraft and helicopters powered by the nine-cylinder Leonides. This compact air-cooled radial is provided with single-lever control acting upon an automatic Hobson fuel-injection carburettor. In helicopters, the engine can be mounted vertically, and the reduction gear is removed to a position immediately beneath the hub of the rotor. Integral with the engine are a clutch and cooling fan.

The cylinder assembly poses a lengthy development problem in a new piston engine and it augers well for the Leonides Major that it has a virtually identical cylinder; 14 are employed in two rows. Reducing the number of "pots" per row has made possible a reduction in crankcase diameter, and the Major has the remarkably small overall diameter of 38.9in. A very efficient cowling has been evolved for fixed-wing installations, with four petal-type panels. This complete installation has been extensively test-flown in the Handley Page H.P.R.5, and is now used in the production Herald transport.

A special version of the Major, illustrated, has been evolved for helicopter propulsion. One of the most important applications of this engine is the powering of one version of the Bristol 191 anti-submarine helicopter.





Armstrong Siddeley Double Mamba ASMD.3. Power sections similar to ASM.S Mamba. Overall width, 52.8in; height, 44.25in; length, 98.7in; dry weight, 2,200 lb; maximum power, 2,740 s.h.p. plus 770 lb thrust (3,035 e.h.p.) at 15,000 r.p.m. with s.f.c. of 0.71 lb/hr/e.h.p.

ARMSTRONG SIDDELEY MOTORS LTD. *Parkside, Coventry. Tel. Coventry 62666*

Double Mamba. This unusual engine consists of a pair of Mamba power sections attached to a common reduction gearbox. Left- and right-hand components have individual fuel, lubrication and control systems and each drives through its own gear train to a four-blade Rotol 11ft airscrew, the two airscrews being fitted in tandem. Each section has a Rotax twin-cartridge starter, although either half can be windmill-started from the slipstream from the airscrew of the other.

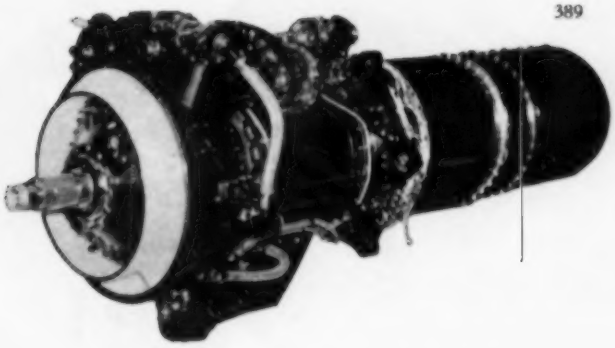
The first production rating was ASMD.1 at 2,850 e.h.p. For the Gannet, such engines have been delivered in quantity during the year from the company's Ansty factory, and these are now fully established in carrier service. Both power sections are normally employed for take-off, although, for ferrying purposes, the Gannet can take off on one power section. In cruising flight one side of the engine is completely shut down and the remainder is operated at a high cruising power corresponding to the bottom of the s.f.c. loop. When necessary, full power from both halves can be achieved within a very few seconds.

A type-test at 3,035 e.h.p. has now been completed by the ASMD.3 and a new range of annular-chamber engines has been started with the ASMD.4, the latter being considerably more powerful than its predecessors. Like the Mamba, the Double Mamba can be run on any standard turbine fuel, including ship's fuel oil, without adjustment.

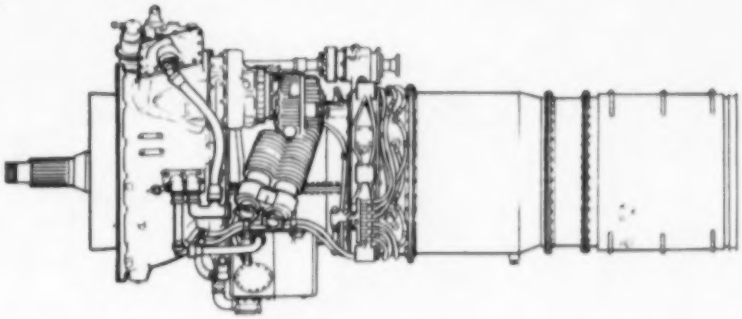
Mamba. Although the history of this neat single-shaft turboprop can be traced back to World War 2, there is no major part of the present engine remaining from the original design. Of the first series of Mambas the ultimate development is the ASM.5 rating, the power of which (1,590 e.h.p.) is 50 per cent greater than the original design figure. This engine has a ten-stage light-alloy compressor, six tubular combustion chambers and a two-stage turbine. Considerable development has been expended upon the combustion system and the cans are now considerably simpler and more efficient than before; all Mambas employ the Armstrong Siddeley type of vaporizing burner of "walking stick" shape.

The engine illustrated drives a single 10ft four-blade Rotol airscrew. Other features of the installation are the twin-breech Rotax cartridge starter, shown in the drawing on the port side, and the drive-shaft along the top of the engine which can transmit power to a remote accessory gearbox.

Later Mambas have an annular combustion chamber reminiscent of that used in the Viper (see next page) and are significantly more powerful and efficient engines. The first of the new range is the ASM.6, and Mambas at this rating went into production during the last 12 months for the Seamew. In spite of the large ventral oil tank, the complete engine-change unit is shallow enough to be accommodated entirely beneath the cockpit floor in this aircraft. Cartridge starting is provided, and engine thrust is varied by altering airscrew pitch while maintaining r.p.m. constant at 15,000. By this means a very rapid response is achieved, suitable for the requirements of carrier operation.



Armstrong Siddeley Mamba ASM.5 single-shaft turboprop. Ten-stage axial compressor, six combustion chambers and two-stage turbine. Mass flow, 18.5 lb/sec; pressure ratio, 5.35:1. Overall diameter, 33in; overall length, 88.2in; dry weight, 820 lb; maximum power, 1,480 s.h.p. plus 300 lb thrust (1,590 e.h.p.) at 15,000 r.p.m. with specific fuel consumption of 0.71 lb/hr/e.h.p.

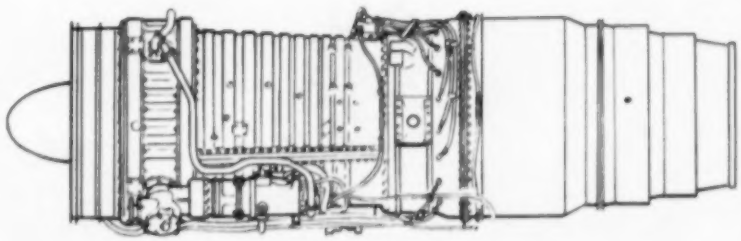


Sapphire. Without doubt one of the most important turbojets in the Western world, the Sapphire is being built in quantity at Brockworth in Gloucestershire and also in the U.S.A., where Curtiss Wright and Buick have already delivered over 6,000 of an Americanized version, designated J65. Details of the British Sapphire are restricted, but the J65 is known to have a 13-stage axial compressor with steel blading, a truly annular combustion chamber with 36 vaporizing burners, and a two-stage turbine.

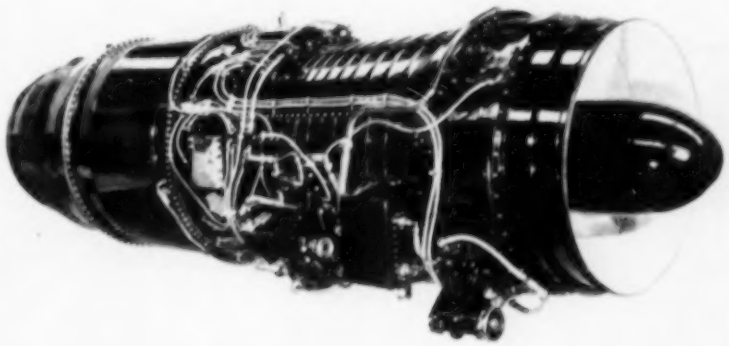
Progressive development culminated in 1953 with the ASSa.6 type-test at 8,300 lb static thrust, and similar engines rated at 8,000 lb thrust have entered service in large numbers during the past year in the Hunter 2 and 5. In service, these engines have performed outstandingly well and are very popular. An up-rated Sapphire 6 is designated Sapphire 12 and this engine has been type-tested at 8,500 lb. A considerable amount of successful flying has also been achieved by a Canberra powered by two Sapphires fitted with afterburners. In the prototypes of the English Electric P.1, Sapphires have been flown at very high Mach numbers, and supersonic afterburner trials will also be carried out in such aircraft.

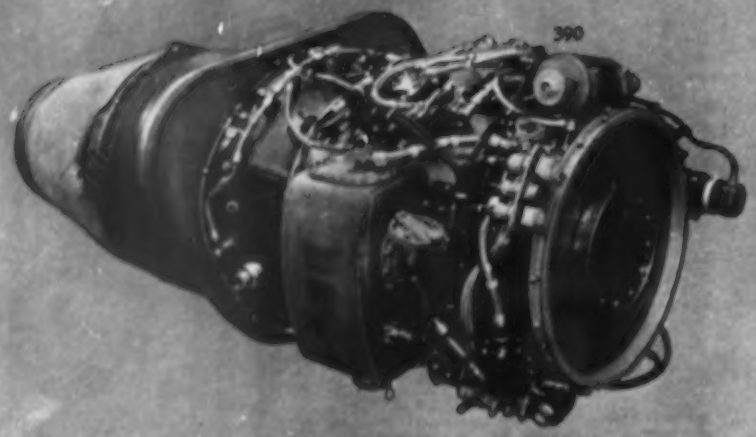
Two years ago a redesigned Sapphire was evolved in order to provide a great increase in thrust. To achieve this alone would pose no insuperable problem; the engine could be run hotter and would then give more power at the expense of a rise in specific fuel consumption. It is noteworthy, therefore, that the Sa.7, the first of the new series to be type-tested, provides 32 per cent more thrust, yet actually has an improved s.f.c. These Sapphires have increased mass-flow.

Engines of this revised type have now gone into production at a type-tested rating of 10,500 lb. The Sa.9 has also been run at great thrust, and other engines are the Sa.4 (which gives 9,700 lb thrust) and the Sa.5 and 8, all of which are undergoing development running.

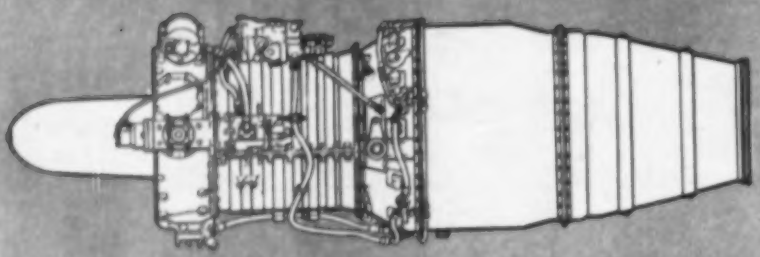


Armstrong Siddeley Sapphire ASSa.7 turbojet. Axial compressor, annular combustion chamber and multi-stage turbine. Mass flow and pressure ratio, not released; maximum diameter, including accessories, 37.4in; overall length, as shown, 132in; dry weight (including anti-icing, turbostarter, high-energy igniters and oil tank), 3,075 lb; maximum rated thrust, 10,500 lb at 8,600 r.p.m. with specific fuel consumption of 0.885 lb/hr/lb.

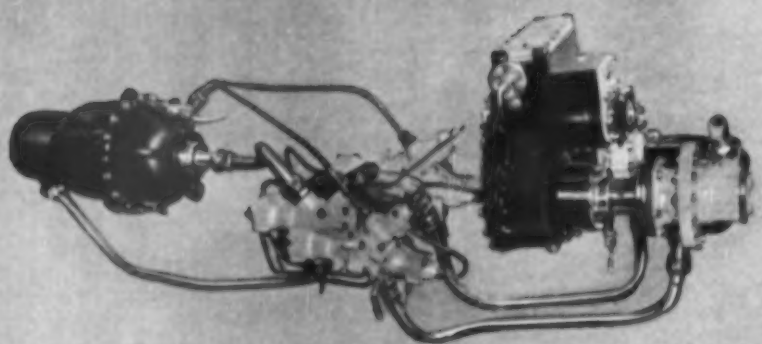




Armstrong Siddeley Viper ASV.8 turbojet. Seven-stage compressor, annular combustion chamber with vaporizing burners and single-stage turbine. Mass flow, 30 lb/sec; pressure ratio, 5.5:1. Overall diameter, 24.7in; length, as shown in drawing, 65.4in; dry weight, including oil tank, two ignition units, and Graviner spray ring, 915 lb. Maximum thrust, 1,640 lb at 13,400 r.p.m. with specific fuel consumption of 1.09 lb/hr/lb.



Armstrong Siddeley Snarler. Dimensions: chamber length, 23.4in to end of mounting cone; nozzle diameter, 5.41in; thrust area, 5.21 sq in; characteristic length, 94in. Weight: gearbox, drive and pumps, about 77 lb; valves, liners, bustles and electric gear, about 57 lb; chamber and mounting, igniter, valves and electrical gear, about 79 lb; total, approximately 213 lb. Note: according to the S.B.A.C. definition of a motor the Snarler's dry weight would be about 166 lb. Performance: full thrust, about 2,000 lb at sea level, rising with altitude. Specific impulse, 198 maximum at sea level; maximum combustion chamber pressure, 300 lb/sq in; maximum combustion temperature, approximately 2,650 deg K; jet velocity, 6,370ft/sec.



Viper. Originally, the Viper was intended to be a cheap turbojet for expendable applications and the design was accordingly simplified to this end. The first production engine was the ASV.3, which has been built in large numbers at the design rating of 1,640 lb thrust and has been shipped to Australia for installation in the Jindivik 2 target aircraft. In this form the Viper has a simplified fuel system and the minimum number of accessories, starting being carried out by an external source of shaft power applied to a socket on the engine.

Early development running established so good a life that a new requirement was written around the Viper for the development of an engine suitable for the propulsion of manned aircraft. The first engine of this range is the ASV.5, at the same rating as the 3 but fully equipped with all normal accessories and with no compromises made in choice of material. As the Viper 101, such engines are being used in the Jet Provost, the transonic Midge prototype and the supersonic French Trident. Behaviour of these engines at very high altitudes has now been explored with a unit mounted under the starboard wing of a Canberra.

An afterburning Viper first ran over a year ago. Designated ASV.7R, this engine is based on the 5 and gives 2,470 lb thrust. Such an engine is also being developed in France by Avions Marcel Dassault, who hold a manufacturing licence for the Viper and have now started production of an engine designated MD.30. In Britain an uprated Viper 5, styled ASV.8, has been run at 1,750 lb thrust. The ASV.10, listed in the data table on page 407, does not yet exist. This engine will fit the same frame as do its predecessors but it will have a greater mass flow and be significantly more powerful.

Aircraft Rockets. The Armstrong Siddeley company were pioneers of liquid-oxygen aircraft rocket motors. In fact, the company's Snarler, illustrated alongside, was the first unit incorporating a pump-fed liquid oxygen supply ever to be designed and flown in a manned aircraft.

Designed as a booster unit for fighters to give a sea-level thrust of 2,000 lb (and rather more at altitude) the Snarler ran on liquid oxygen and a 65/35 per cent mixture of water and methanol. These propellants were supplied at high pressure by centrifugal pumps, the liquid oxygen being injected directly into the head of the combustion chamber and the water-methanol mixture being passed through a regenerative cooling jacket surrounding the combustion chamber itself, final entry to the combustion chamber being made through holes in the wall. The Snarler was test flown in a Hawker Nene-powered fighter, the turbojet being employed to drive the rocket pumps through a mechanical gearbox. In the accompanying photograph, the pumps, valves and combustion chamber have been rearranged in more compact form for display purposes. The valve-group in the centre provided automatic control to facilitate safe starting and to enable the unit to be governed by a single lever in the cockpit.

Earlier this year the company announced the existence of a rocket motor with the name Screamer. It was then stated that the propellants employed were aviation turbine fuel in conjunction with an oxidant which, to judge by the installations at the company's rocket division at Ansty, is likely to be liquid oxygen. The mechanical details of the Screamer are entirely withheld, as are details of its progress, with the exception of one significant fact: the Screamer has already completed a considerable amount of development running and the thrust obtained has exceeded the design figure. It is highly likely that this design thrust is considerably greater than that for the Snarler.

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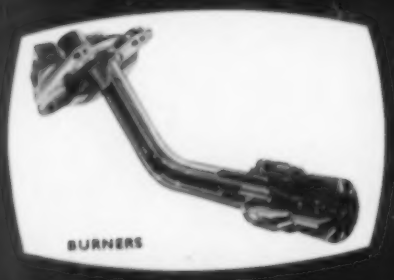

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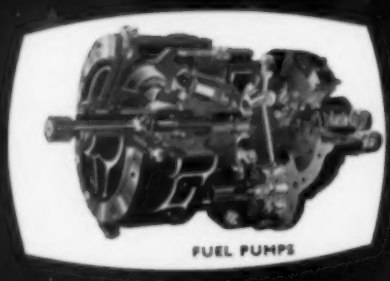

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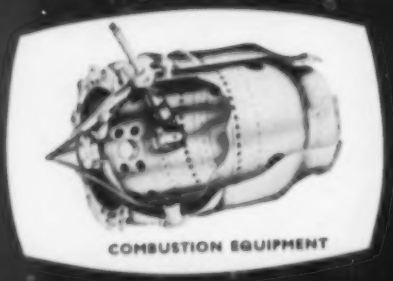
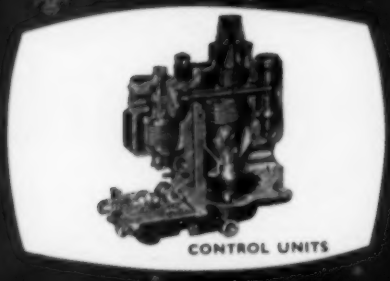


COMBUSTION EQUIPMENT



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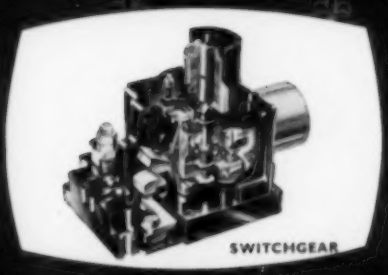
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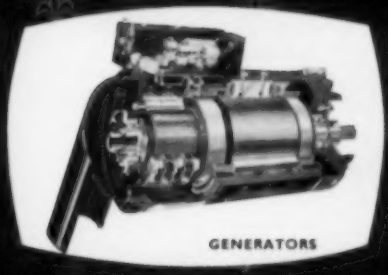
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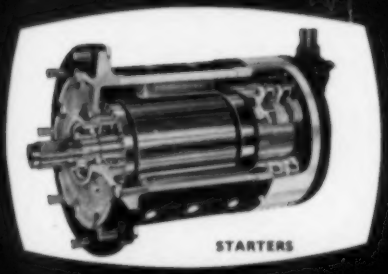
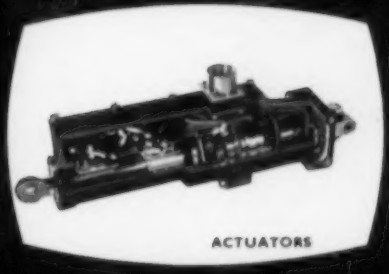

STARTERS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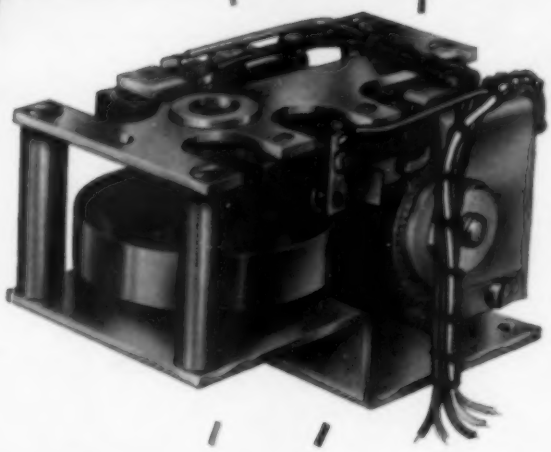

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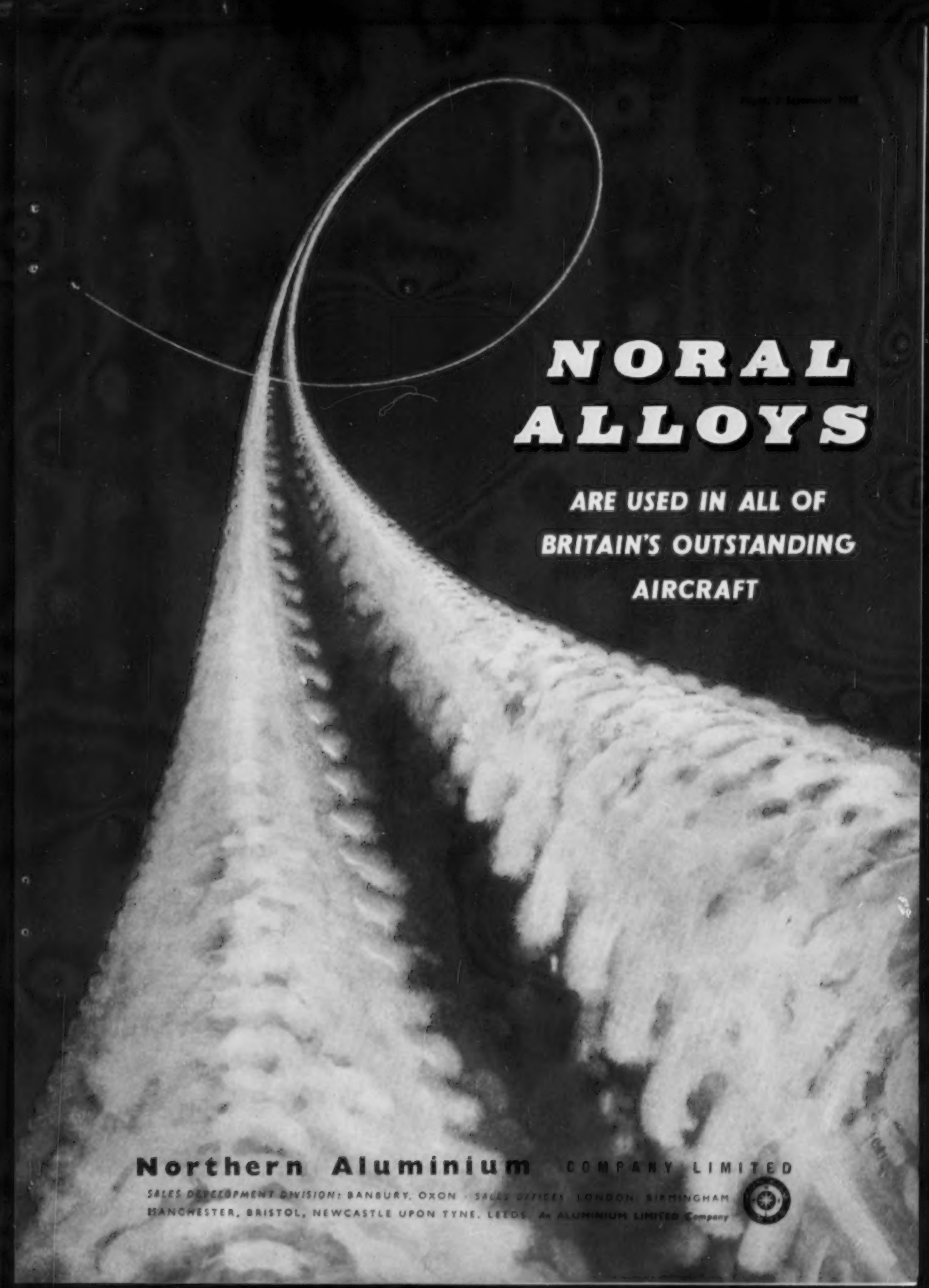
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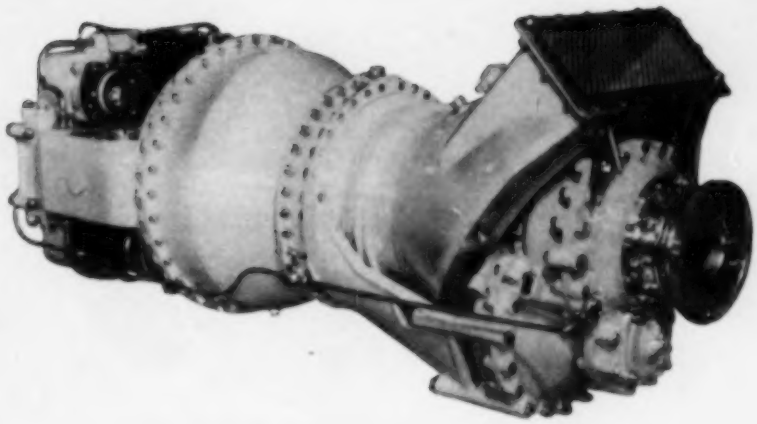
Gas Turbines. During the past three years, Blackburn and General Aircraft have been developing a rationalized range of small gas turbines based on the engines developed by the French Turboméca company. All these engines have a single-sided centrifugal compressor and a novel annular combustion system into which fuel is sprayed by radial drillings in the tubular compressor shaft. Blackburn have carried out complete redesign, one of the major undertakings having been the provision of a comprehensive range of accessories. These are now carried on any of 12 drive-faces at the front of the engine, above and below the bifurcated intake casting, which is itself a Blackburn development.

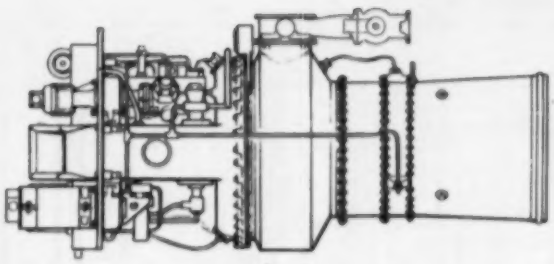
The Artouste is a single-shaft turboprop. An extra turbine stage has been added at the rear, and a reduction gear at the forward end. Although obviously suitable for aircraft propulsion, the first production application of the engine is in an auxiliary generating plant for a medium bomber.

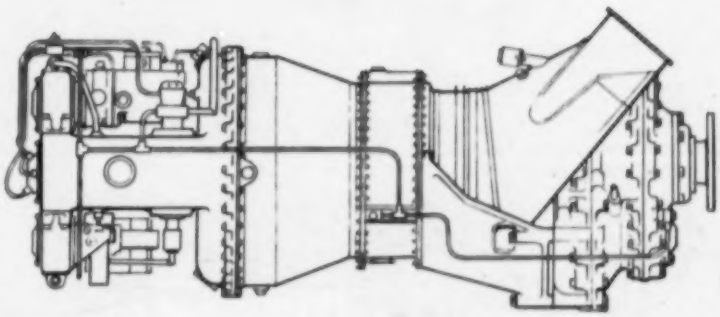
The Palas is a simple turbojet. Although it is fitted to a number of prototypes there is no production application at present.

The Palouste is a gas producer for helicopter propulsion. Compressor air is divided in the ratio 2.5:4.7, the latter portion being used for combustion and for driving the turbine. The former fraction is tapped off and ducted up to the rotor, where it is expelled from propulsive nozzles at the blade tips. The Palouste has completed three 150-hr unofficial type tests and is in production for the Fairey light A.O.P. helicopter.

Most important of the range, at present, is the Turmo. This is a free-turbine engine, shaft power being extracted from the rear of the engine and the exhaust being ducted away upwards. A wide range of reduction-gear ratios is available, and the full-power output speed can be anything from 819 to 36,000 r.p.m. For the Westland Whirlwind there has been developed a coupled version of this engine, known as the Twin Turmo. Both power sections are geared to a common output shaft, free-wheels being provided to enable either power section to continue to drive in the event of the other half of the engine being shut down. In the Whirlwind the Twin Turmo will be mounted at an angle of about 35 deg from horizontal. The BnTC.1 rating specifies a delivery of 908 s.h.p., sufficient to confer a great increase in performance to the Whirlwind, and provide twin-engine safety.







Reading from the top: Blackburn-Turboméca Turmo, Palouste, Turmo.

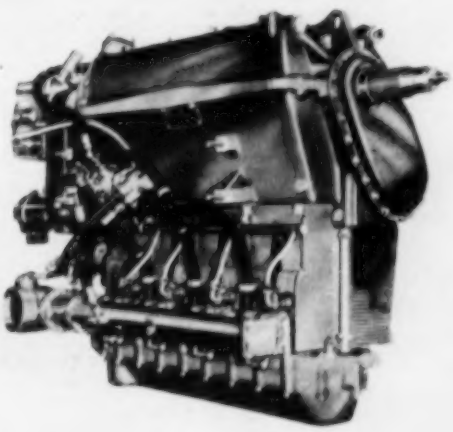
Turmo, free-turbine shaft-drive engine, with single, single-sided centrifugal compressor, annular combustion chamber with rotating fuel-injection nozzles, and single-stage turbine. Additional turbine stage added at rear and driving reduction gear to output coupling. Overall width, 17.1in; height, 21in; length, 46.12in; dry weight, with typical reduction-gear ratio, 281 lb; mass flow (Turmo 600), 7.19 lb/sec; pressure ratio, 4.12:1; maximum power, 450 b.h.p. at 36,000 r.p.m. with specific fuel consumption of 1.04 lb/hr/b.h.p.

Palouste, air-compressing gas turbine. Basic identical with Turmo, described above, except that only one turbine stage is used. Maximum diameter, 17.7in; height, about 18in; length, basic engine, 28.62in; dry weight, 178 lb; delivery, 2,725 lb/sec air at 41.55 lb/sq in gauge, with fuel consumption of 310 lb/hr.

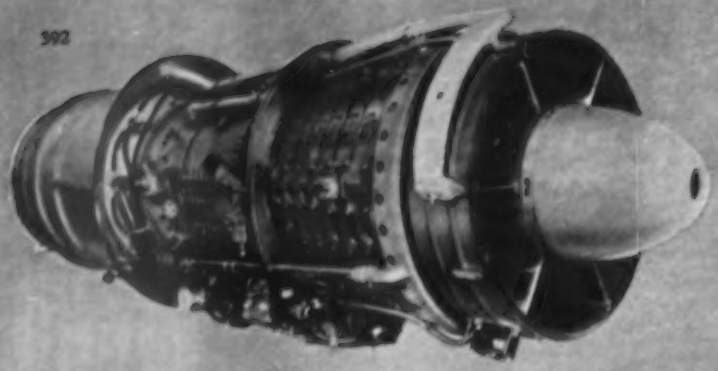
Piston Engines. Production of the Cirrus Bombardier is continuing, and seems likely to be maintained for at least the forseeable future. The engine is employed in the Auster A.O.P.9, standardized by the British Army, and a variant of the Bombardier has also been used in the Saro Skeeter helicopter.

It is a modern, four-cylinder inverted air-cooled unit, employing direct injection. A considerable proportion of the main structure of the engine is of magnesium alloy and an unusually comprehensive range of accessories (for a small engine) can be fitted, including a constant-speed unit. In the A.O.P.9, the Bombardier has a cartridge starter. On ordinary military M.T. fuel the Bombardier 203 gives 173 rated h.p., but figures well in excess of 200 h.p. are attainable with high-octane petrol.

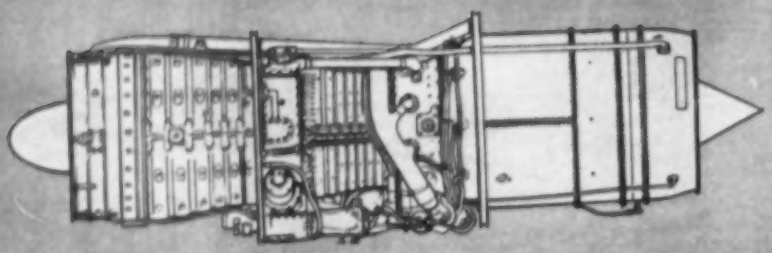
Deliveries also continue of the earlier Cirrus Major, of similar layout but employing a float-type carburettor. The Major is exported for use in the Hindustan HT-2 trainer.



Cirrus Bombardier 703, inverted four-in-line, air-cooled and with direct fuel injection. Bore, 4.8in; stroke, 5.5in; swept volume, 389.12 cu in (6.524 litres); width, 17.2in; height, 31.1in; length, 46.8in; dry weight, 350 lb; maximum power, 175-200 b.h.p. at 2,600 r.p.m. at sea level.



Bristol Olympus 101 turbojet. Low-pressure axial compressor, high-pressure axial compressor, cannular combustion system, high-pressure turbine and low-pressure turbine. Mass flow and pressure ratio not available for publication. Diameter, 48in; overall length, about 124in; dry weight, 3,660 lb; maximum type-tested thrust, 11,000 lb at 6,500 (low-pressure) r.p.m. with an s.f.c. of 0.79 lb/hr/lb.



THE BRISTOL AEROPLANE CO., LTD. (ENGINE DIVISION) *Filton, Bristol*
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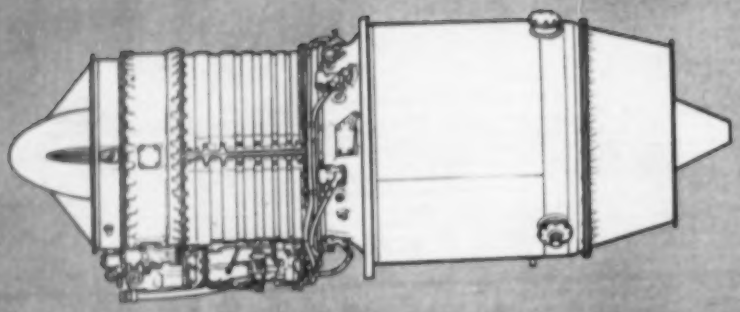
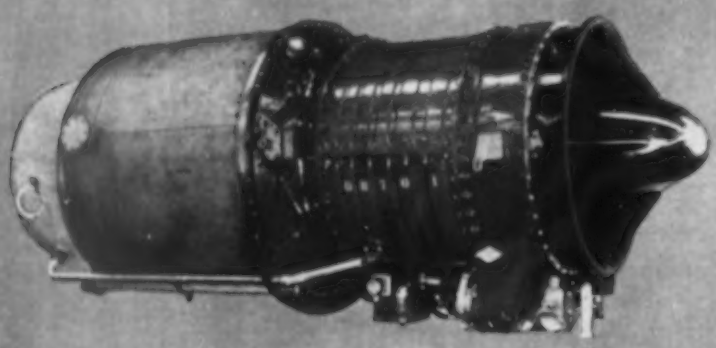
Olympus During the past year the Olympus passed into production for the Avro Vulcan medium bomber, with a type-test rating of 11,000 lb thrust. First of the Bristol two-spool engines, the Olympus has high- and low-pressure compressors which automatically match themselves to their optimum conditions of r.p.m. according to the setting of the pilot's power lever. At low speeds, the high-pressure section of the engine turns roughly twice as fast as does the more massive low-speed assembly; but, as the engine is opened up, the ratios change until the final figures are: high-pressure, 8,500 r.p.m.; low-pressure, 6,500 r.p.m.

This method of compound-compression has enabled Bristol designers to achieve a very high pressure ratio without incurring any penalty in flexibility of handling. In turn, this has made possible the achievement of outstandingly good specific fuel consumption; the figure is 0.79 at full power and the loop drops to 0.75 at a cruising thrust of 8,000 lb. Other startling figures are the continuous cruising output of 9,600 lb and the acceleration time of 5 sec from idling to maximum power.

Notwithstanding this excellent performance, the Olympus basic design is being steadily developed to provide a family of engines of outstanding power and efficiency. It was recently reported in America that the developed Olympus had been run on the bed at 16,000 lb thrust; the report went on to state that "the Olympus 106 and all succeeding modifications are designed for supersonic speeds."



Bristol Orpheus BOr.1 turbojet. Single axial compressor with a small number of stages of light-alloy blading, cannular combustion chamber and turbine. Overall diameter, 32.4in; length, 90.25in; dry weight, 746 lb; mass flow and pressure ratio, not available for publication; maximum type-tested thrust, 3,285 lb at unassisted r.p.m.



Orpheus This year the Orpheus turbojet has broken all records for rapidity of gas turbine development. The company only decided to develop the engine, as a private venture, late in 1953. The first prototype ran on December 17th last year, yet a 150-hr type-test was successfully completed within five months, and over 2,400 hr running have now been completed. Flight development began on July 18th, with the first flight of the Folland Gnat supersonic fighter prototype.

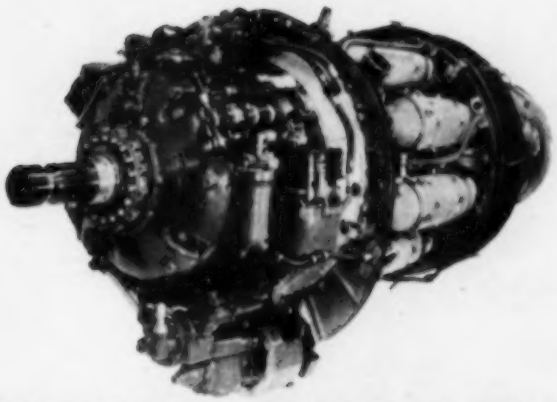
As the illustrations show, the Orpheus has a single short axial compressor—it is actually aerodynamically similar to the low-presure compressor of the B.E.25 turboprop, but with aluminium, instead of steel, blades—and a combustion chamber which appears to be of the annular or cannular type. The whole engine is extraordinarily short and squat and is, no doubt, one of the easiest of all powerplants to install.

During its first type-tests the thrust achieved was 3,285 lb, and this has already established the Orpheus as having the best thrust/weight ratio of any type-tested engine, with a figure of 4.4 lb-thrust per lb-weight. Nevertheless, considerably higher thrusts were being achieved even at the time of the type-test and it may be expected that higher values will shortly be announced. It is also known that jet-pipe augmentation is scheduled for use with the Orpheus, either in the form of a full-blown afterburner or, according to persistent unofficial reports, by what is known as Bristol simplified reheat, about which nothing has yet been made public. Production Orpheus may be delivered next year for a variety of high-speed military aircraft. The design of the engine is outstandingly good and there is no doubt that it will be very popular and widely used.

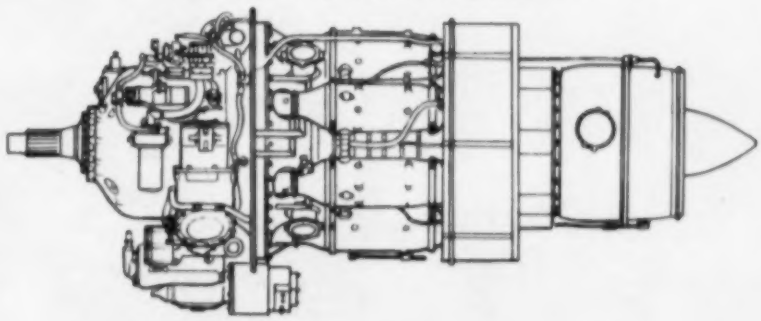
Proteus First high-power turboprop in the world to be given clearance for unrestricted passenger carrying, the Proteus is unique in that it has never had any military application. It is a reverse-flow engine, the air passing forwards through twelve stages of steel blades, outwards in a centrifugal stage and then back through the eight tubular combustion chambers. The hot gases then leave *via* the spaces between the intake trunks and pass through four turbine stages: the high-pressure pair drive the compressor and the downstream pair drive a double-helical reduction gear, carried in a torquemeter, which transmits the drive to the single airscrew.

As the power-turbine/airscrew assembly is mechanically independent from the rest of the engine, it begins to rotate only when the gas flow has built up to a sufficiently high value, the electric starter being geared to the compressor assembly. A brake is fitted in order to bring the airscrew to rest after shut-down and to prevent windmilling when the aircraft is parked. The Britannia 100 is powered by the 3,780 e.h.p. Proteus 705, which has a mechanical drive to a Rotol accessory gearbox. Later Britannias have the engine illustrated, which drives a 50 kVA Rotax alternator, all accessories then being electrically driven. Airscrew and compressor sections have their own lubrication systems so that electrical power can be obtained from a shut-down power unit by allowing the airscrew to windmill. An overspeed governor is fitted to prevent dangerous overspeeding of the power turbine in the event of its being taken off-load. In the Britannia, all the cabin-pressure air is tapped from the compressor and hot gas for de-icing is extracted from the turbine.

The Proteus has already run over 40,000 hours and is almost completely developed. Production deliveries are proceeding on schedule.



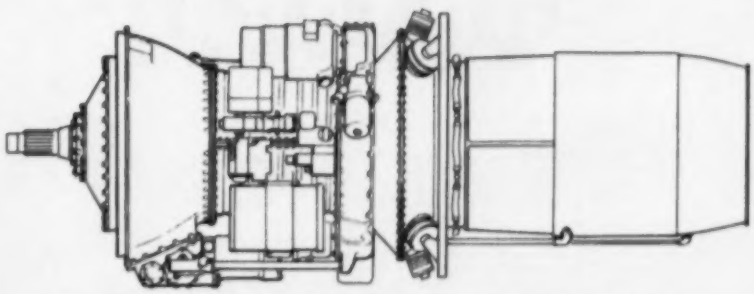
Bristol Proteus 753 free-turbine turboprop. Twelve axial stages of steel blading, one centrifugal stage, eight combustion chambers, two-stage high-pressure turbine driving compressor assembly, two-stage low-pressure turbine driving airscrew. Diameter, 40.1in; overall length, 108.7in; dry weight (to E.D.M. 25), 3,000 lb; mass flow, 47 lb/sec; pressure ratio, 7.2:1; maximum power, 3,650 s.h.p. plus 1,220 lb thrust (4,120 e.h.p.) at 12,000 compressor r.p.m. (11,100 power-turbine r.p.m.) with s.f.c. of 0.6 lb/hr/e.h.p.; cruising s.f.c., around 0.48 lb/hr/e.h.p.



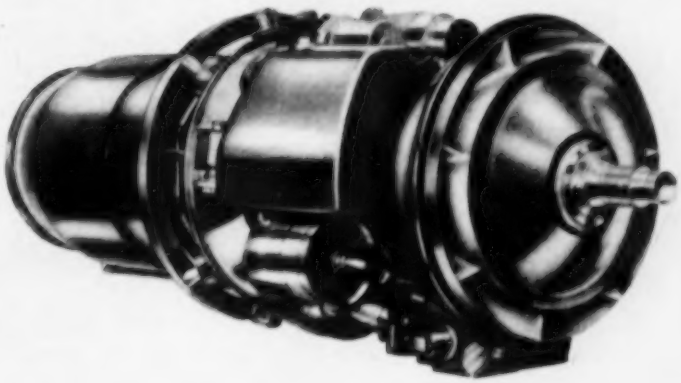
B.E.25 Described by Dr. S. G. Hooker, its designer, as a supercharged turboprop, this engine is the first gas turbine yet designed which is not a full-throttle engine at sea-level. The engine is deliberately throttled to a maximum of 4,000 shaft horse-power at sea-level although it is potentially capable of very much greater power. This has made possible the use of a reduction gear and airscrew assembly not greatly different from that already fully developed for the Proteus. As the aircraft climbs, the throttle of the B.E.25 can be opened progressively until the full-throttle height, which can vary up to 20,000ft according to air temperature, is reached.

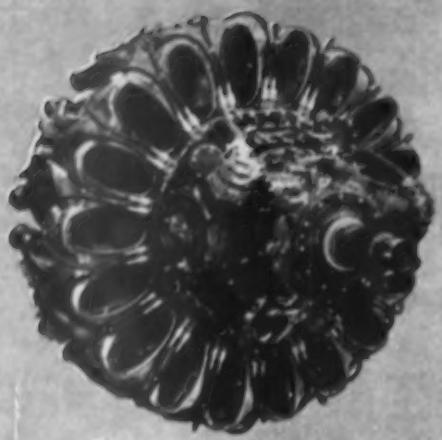
Previously, turboprops have tended to err on the side of excessive sea-level power; the aim at Bristol has been to achieve minimum powerplant weight by restricting take-off power roughly to that required for cruising at 25,000 to 35,000ft. It has been reported that the B.E.25 can provide a cruising power of 4,300 e.h.p. This also has the effect of removing any take-off limitations which might otherwise be imposed by conditions of airfield height, temperature and humidity. The B.E.25 has a two-spool compressor, the high-pressure section being driven by the high-pressure turbine stage and the low-pressure section, together with the airscrew, being driven by the three-stage low-pressure turbine. The combustion system is of the cannular variety with flame tubes very similar to those employed, with great success, in the Proteus.

A considerable amount of component running has already been completed and extremely high efficiencies have been recorded. The engine is expected to run as a unit before the end of the year, and may be available for commercial service within the following three years.



Bristol B.E.25 turboprop. Low-pressure axial compressor with steel blading, high-pressure axial compressor with steel blading, cannular combustion system with 10 flame tubes, single-stage high-pressure turbine driving high-pressure compressor and three-stage low-pressure turbine driving low-pressure compressor and airscrew. Overall diameter, 41.75in; overall length, 110.3in; dry weight (including oil tank and coolers, rigid mounting units and starter), 3,050 lb; mass flow, 86 lb/sec; pressure ratio, about 10:1; maximum power, 4,050 s.h.p. plus 2,730 lb thrust (5,050 e.h.p.) at 10,500 l-p compressor r.p.m. up to 16,500ft (i.s.a.c.) altitude; typical maximum cruising rating, at 36,000ft and 350 kt under i.s.a. conditions, l-p compressor r.p.m. 8,860, turbine entry temperature 1,000 deg K, h-p compressor r.p.m. 8,700, mass flow 25.8 lb/sec, total power, 3,080 e.h.p., fuel flow 1,185 lb/hr, specific fuel consumption 0.508 lb/hr/e.h.p. or 0.385 lb/hr/e.h.p.



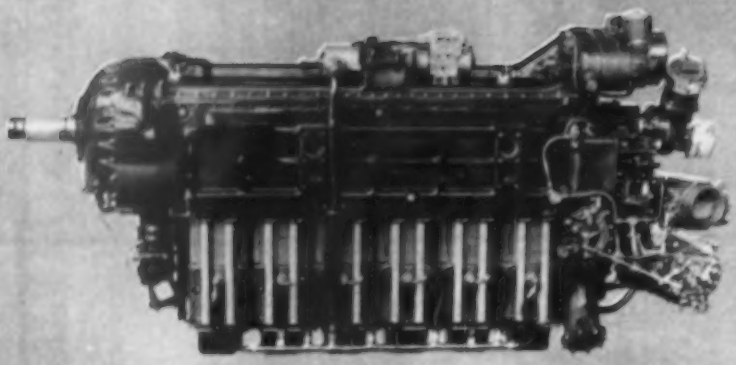


Bristol Centaurus 173, 18-cylinder two-row sleeve-valve radial piston engine; geared and fitted with single-stage, single-speed supercharger. Bore, 5.75in; stroke, 7in; swept volume, 3,270 cu in (53.6 litres); overall diameter, 55.3in; length, 74in; dry weight, 2,400 lb; maximum rated power, 2,935 b.h.p. at 2,800 r.p.m. at 4,000ft with w/m injection (3,850 h.p. available for take-off).

Piston Engines Both the Hercules and Centaurus sleeve-valve radials continue in production, the principal application for the former being in the Bristol 170 Freighter (and, supplemented by Hercules built in France by S.N.E.C.M.A., the Noratlas military and civil transport). The Centaurus is being delivered for the Beverley.

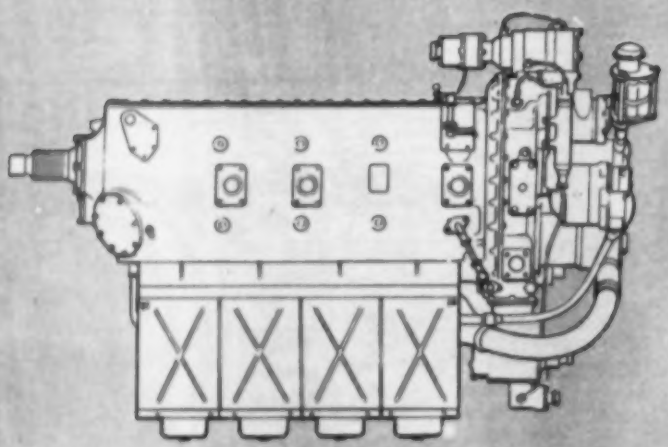
The Beverley is the application responsible for most of the current Bristol piston-engine development. At present, it uses the Centaurus 173, as illustrated here, and this engine has a single-speed supercharger and a relatively low rated height (and, conversely, a greater take-off power than the generally similar engines used in B.E.A.'s fleet of Elizabethan airliners).

Special mention should be made of the new range of Centaurus being developed with direct fuel injection into the cylinder heads. These engines have already completed a total of over 1,300 hr bench-running and test-flying is well under way. The first of this range is designated Centaurus 373, and provides a maximum power of no less than 3,220 b.h.p., with 3,150 h.p. available for take-off at sea level. This engine will shortly pass into production for the Beverley.



Above: **de Havilland Gipsy Queen 70 Mk 2**, six-cylinder inverted in-line air-cooled engine, geared and supercharged and with injection-type carburettor. Bore, 4.72in; stroke, 5.9 in; swept volume, 622 cu in (10.2 litres); width, 18.7in; height, 33in; length, 70.8in; dry weight, 690 lb; maximum power, 380 b.h.p. at 3,000 r.p.m. at 7.5 lb boost at sea level.

Below: **de Havilland Gipsy Major 200**, four-cylinder inverted in-line air-cooled engine, ungeared and unsupercharged, with inlet-port fuel injection. Bore and stroke as above; swept volume, 416 cu in (6.79 litres); overall width, 16.8in; height, 29.8in; length, 51in; dry weight, 400 lb; maximum power, 192-200 b.h.p. at 2,600 r.p.m. at sea level.

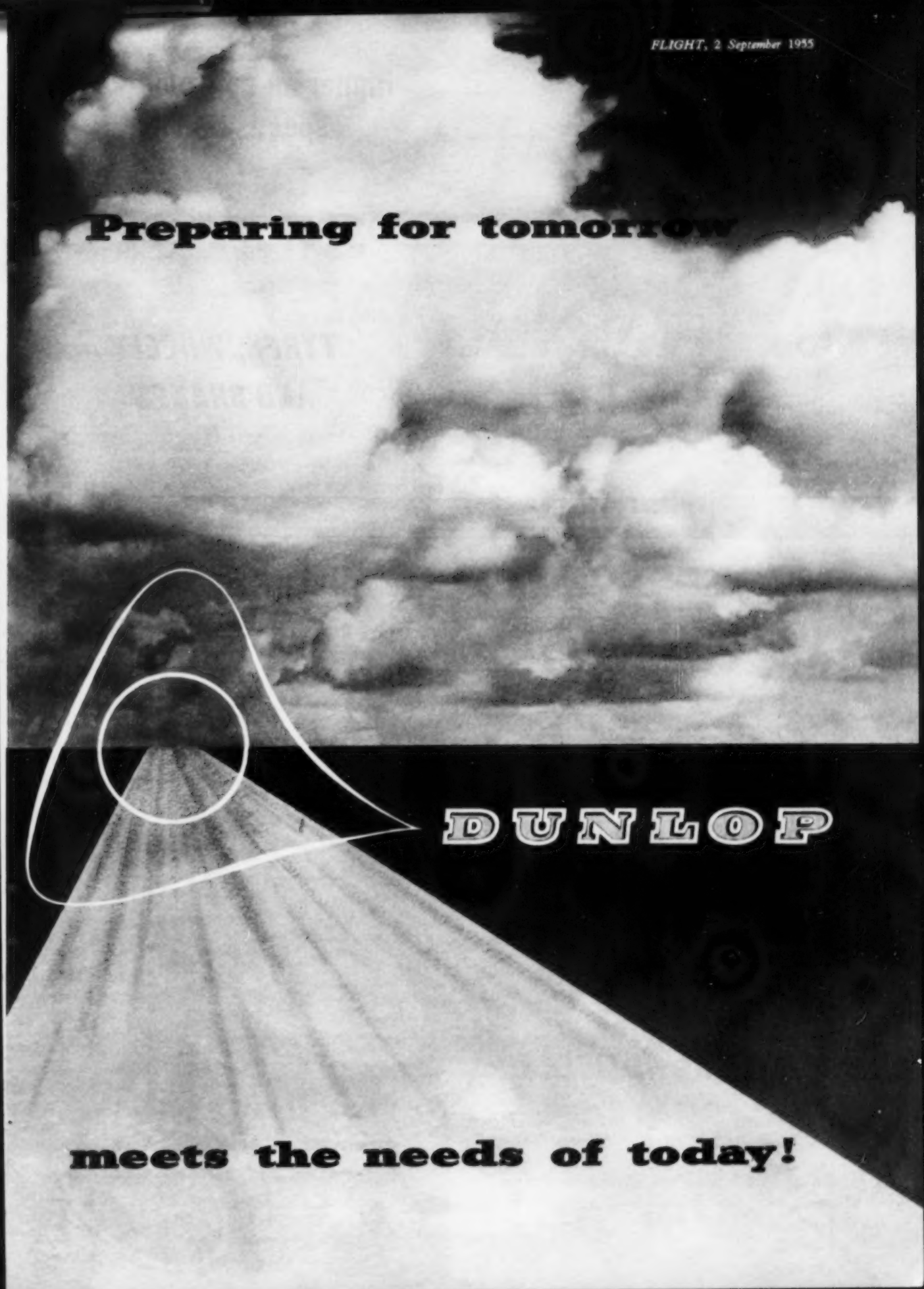


THE de HAVILLAND ENGINE CO. LTD. *Leavesden Aerodrome, Herts Tel.: Garston 4000*

Piston Engines The drawing shows the Gipsy Major 200, in its helicopter version (as installed in the Saro Skeeter 6). Progressive development during 27 years has resulted in this finely engineered unit, which incorporates many features proved in service with the post-war range of six-cylinder engines. In particular, the Major 200 has the Gipsy Queen-size cylinder, resulting in a greater swept volume. It is a normally aspirated engine, with a direct drive.

A completely new feature is the employment of inlet-port fuel injection, in place of the original float-type carburettor. Apart from eliminating icing problems, this has resulted in near-perfect fuel distribution in an induction system of very high aerodynamic efficiency. The power is, in consequence, equal to that given by the pre-war six-cylinder Gipsies. Provision is made for a wide range of accessories—some of which are shown in the drawing—and a fixed-wing version is available. A special development is also being prepared for operation on ordinary M.T. fuel, with a slightly reduced power rating.

The photograph is of a production Gipsy Queen 70, similar to the thousand or more engines now used in Doves all over the world. This is a supercharged and geared six-cylinder engine, with an injection-type carburettor. It is supplied as a complete engine-change unit. The other production-type Queen is the Series 30 Mk 2, used in the Heron. Supplied as a bare engine, this has a direct drive and a float-type carburettor, and a maximum rating of 250 h.p. A feathering airscrew was recently designed by de Havilland Propellers, Ltd., for the Heron; the Heron uses a two-blade airscrew, whereas the Queen 70 drives a three-blade unit, which can be equipped for reversing.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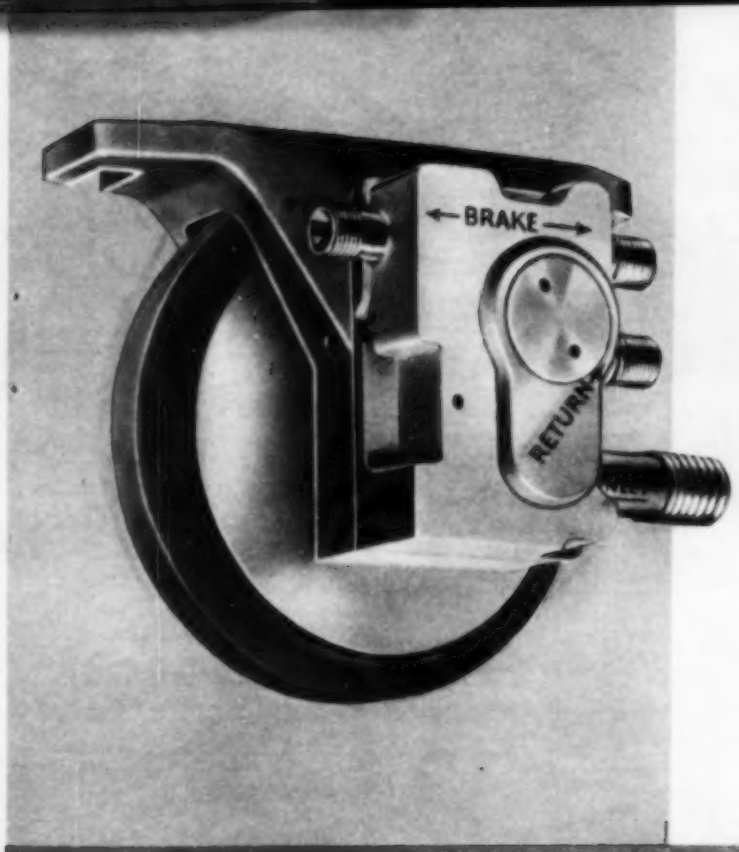

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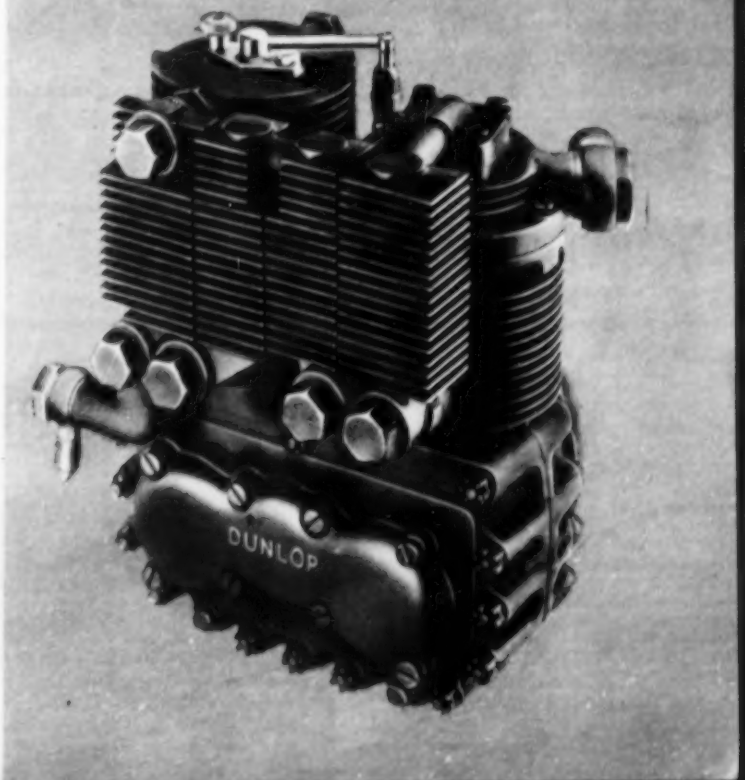

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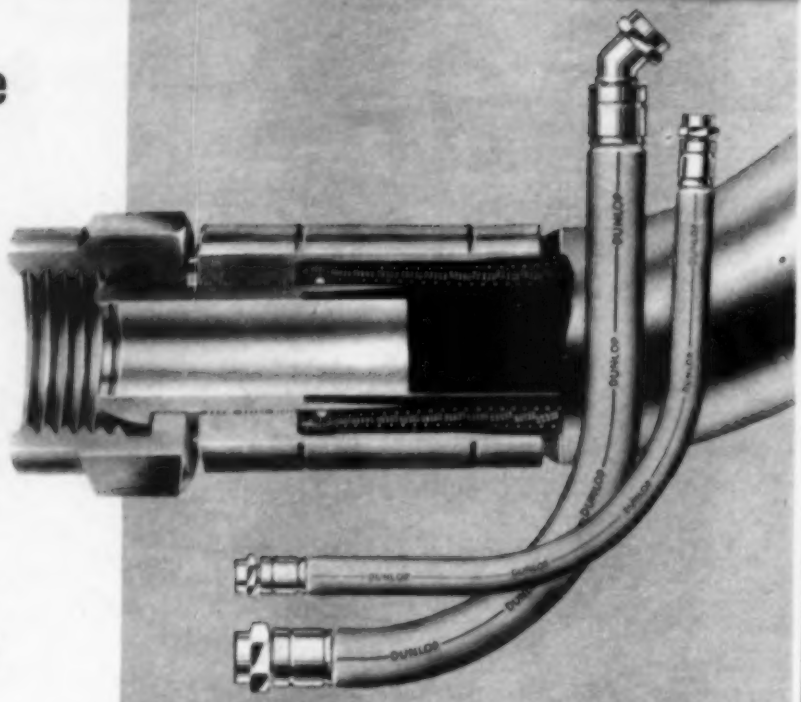

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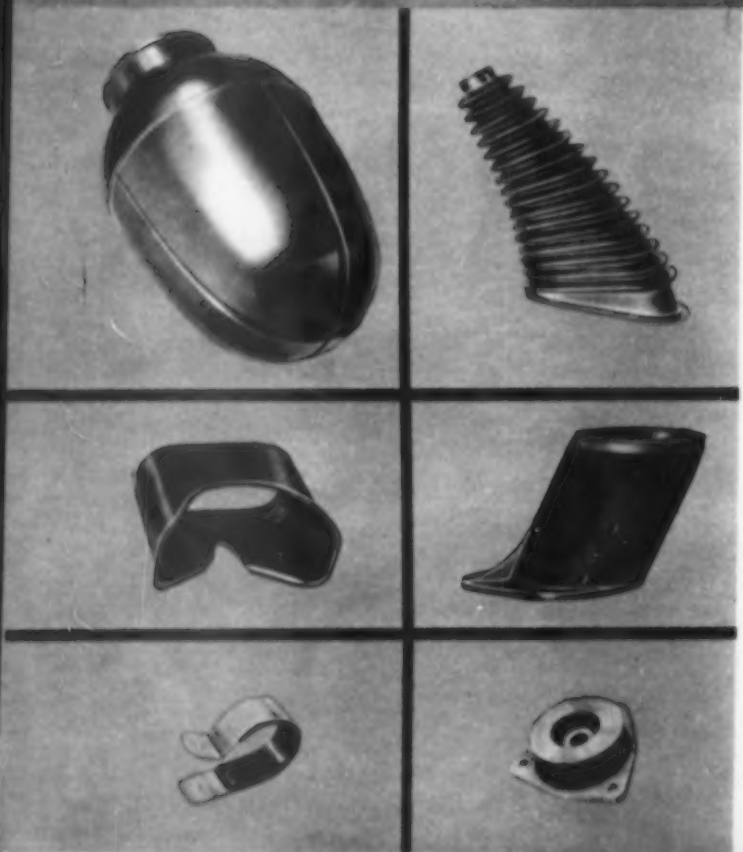

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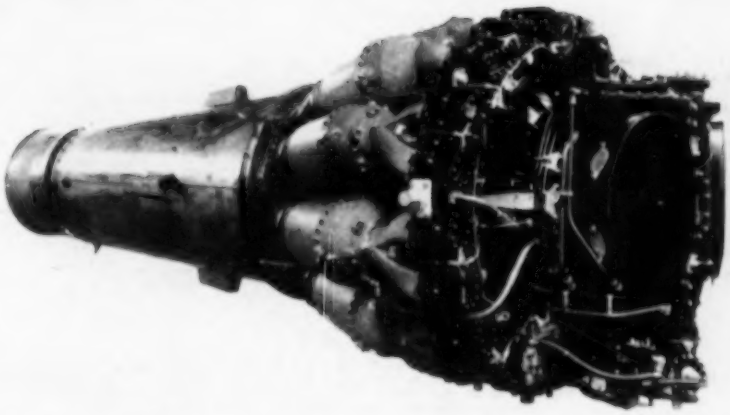
Gyron At the time of writing it is almost certain that this great axial turbojet will make its public bow at the coming S.B.A.C. exhibition. Nevertheless, in the absence of ministerial confirmation, we can record here nothing that is not already known.

The existence of the Gyron was revealed two years ago, and at that time development had already reached an advanced stage. In the original statement was the announcement: "It may be made known that the Gyron was giving very high thrust within the first few weeks of running . . . also that it has given satisfactorily low specific consumption and a high degree of reliability." It is also known that the engine is of an exceptionally simple and rugged nature, yet has a very low weight for its power.

It is, in fact, not merely a bigger version of the axial engines already in service but the precursor of a new generation of turbojets, for which a new generation of airframes must be built. In these airframes it will be often supplemented by rocket power, and it is clear that de Havilland, with characteristic foresight, are developing versions of the Gyron and Spectre in parallel, to form a matched team for supersonic military aircraft. In such applications the Spectre would dominate at altitude, the Gyron providing increased endurance.

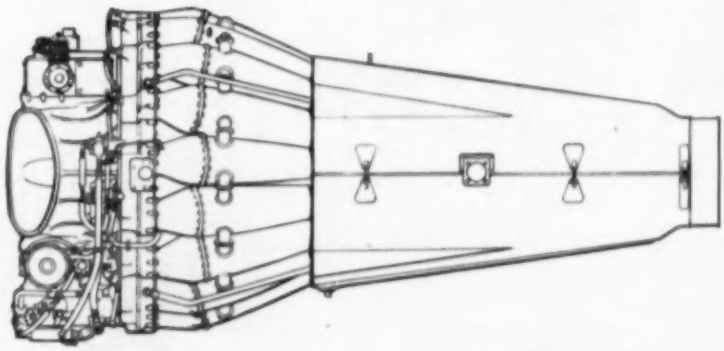
Test-bed time has now reached a very satisfactory figure, with a number of engines available. The first flight was on July 7th last, with an engine mounted in the lower port position on the first Short Sperrin prototype. Flight trials, which are now taking place from Hatfield, are progressing well, and the performance and handling are well up to expectations.

Centrifugal Turbojets No significant changes have been made to the Goblin turbojet, which is in use in all parts of the world and remains in production as the power unit of the Vampire Trainer. The larger Ghost is also in full production, for the several versions of Venom and Sea Venom. The engine illustrated at upper right is the latest that can be published, although ratings DGt.4 and 5 (Ghost 104 and 105) are known to exist, and no doubt represent a significant advance on their predecessors.



Above: **de Havilland Ghost 103** turbojet. Single-sided centrifugal compressor, 10 combustion chambers and single-stage turbine. Diameter, 53in; length, 130.5in; dry weight, 2,175 lb; mass flow, 88 lb/sec; pressure ratio, 4.5:1; maximum thrust, 4,850 lb at 10,250 r.p.m. with s.f.c. of 1.09 lb/hr/lb.

Below: **de Havilland Goblin 35** turbojet. Single-stage, single-sided centrifugal compressor, 16 combustion chambers and single-stage turbine. Diameter, 49.85in; length, 100.5in; dry weight, 1,629 lb; mass flow, 63 lb/sec; pressure ratio, 3.67:1; maximum thrust, 3,500 lb at 10,750 r.p.m. at sea level; s.f.c., 1.14 lb/hr/lb.

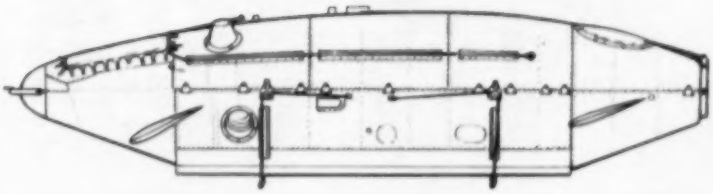


Rocket Motors Both the pioneer de Havilland rockets were assisted-take-off units. The first, named Sprite, was designed for permanent installation in the Comet 1, and obtained thrust by injecting a mixture of concentrated hydrogen peroxide and a catalyst into a reaction chamber, from which the propellants emerged as a brownish jet of superheated steam.

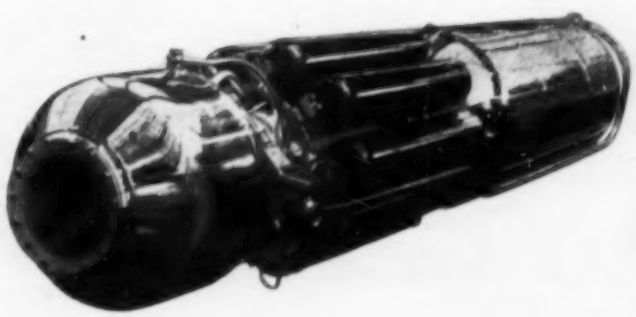
From the Sprite was evolved the Super Sprite, illustrated. Not only does this unit have larger tanks, but the peroxide is decomposed by injecting it through a metal-gauze catalyst. The Super Sprite also has a higher specific impulse, since kerosine is added to the decomposition products and burns therein. The drawing shows the jettisonable nacelle which is now in production for a British military aircraft, one such unit being attached under each wing. Last year the Super Sprite became the first liquid-propellant aircraft rocket to pass a service type-test, and jettison trials have since taken place.

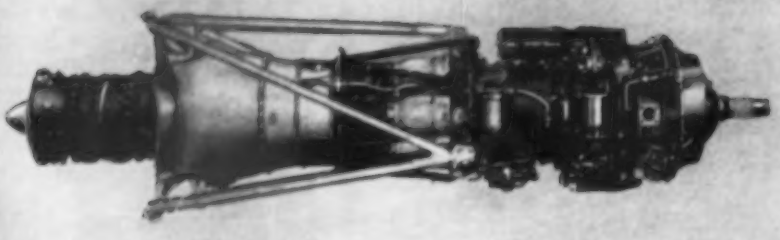
Earlier this year, the de Havilland company were able to announce the existence of the Spectre. This is another liquid-propellant aircraft rocket, and it may be assumed to be of higher output than the Super Sprite. Unlike its predecessors, the Spectre is intended, in some applications at least, for permanent installation in supersonic fighters, in which aircraft it would be matched with a Gyron turbojet. Such a combination of rocket and jet power can be shown to provide unmatched supersonic and high-altitude performance.

Although no details of the Spectre may yet be published it is fair to expect it to be a pump-fed unit, in view of the increased duration of firing. Considerable test-bed firing has been successfully completed, and flight trials are imminent.



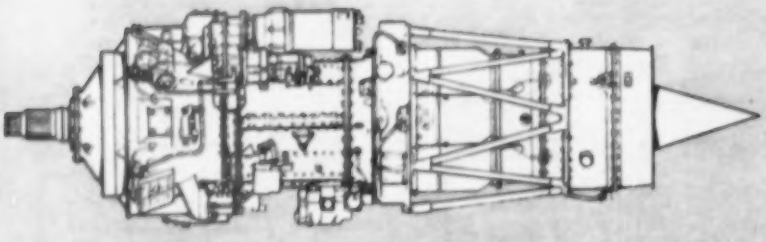
de Havilland Super Sprite a.t.o. rocket pack (photograph shows basic rocket motor). Basic motor: overall dimensions, length, 117½in, diameter, 20½in. Empty weight, 620 lb ±2½ per cent; fuelled weight, 1,460 lb ±2½ per cent. Standard maximum rated thrust, 4,200 lb for 40 seconds total duration (see thrust curve); total impulse, 120,000 lb/sec. Propellants: 57 gal hydrogen peroxide at 80 to 85 per cent concentration and 5 gal kerosine or wide-cut gasoline. Feed by 3,690 cu in nitrogen initially at 2,900 to 3,100 lb/sq in. Nacelle: approximate overall dimensions, length, 150in, height, 32in and width 28in. Total weight nacelle and fuelled motor, about 1,900 lb; full weight of expended nacelle, about 1,100 lb.





Above: **Napier Eland E.121** for Rotodyne. Gas-producer and shaft-drive engine, with layout as fixed-wing Eland (*below*) with the addition of an auxiliary compressor driven by a fluid coupling. Overall diameter, 36in; length, 158.25in; dry weight, 2,350 lb; maximum power, 2,800 e.h.p. plus 500 lb thrust (3,000 e.h.p.) at 12,500 r.p.m.

Below: **Napier Eland NEL1** fixed-wing turboprop. Ten-stage compressor, six tubular combustion chambers with upstream injection and three-stage turbine. Mass flow, 31 lb/sec; pressure ratio, 7.0:1; overall diameter, 36in; length, 122.25in; dry weight, 1,575 lb; maximum power, 2,690 e.h.p. plus 825 lb thrust (3,000 e.h.p.) at 12,500 r.p.m. with s.f.c. of 0.624 lb/hr/e.h.p.



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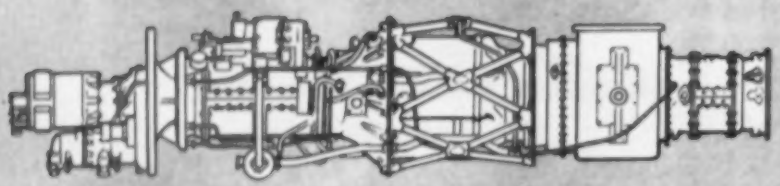
Eland It is doubtful if there is a finer single-shaft turboprop in existence than the Eland, which first ran three years ago and will be available for use from the beginning of next year. The design was based upon the minimum size of spinner for a 3,000 h.p. airscrew, and the whole power-plant fits into a 36in-diameter cowling. As in other Napier engines, aluminium-bronze blading is used in the compressor, which also has a row of inlet guide vanes the angle of which is responsive to turbine inlet temperature. By this means, outstandingly good engine-handling characteristics have been obtained.

Accessibility is particularly good, it being possible to change any combustion chamber or burner without disturbing the remainder of the engine, and to replace either the reduction gear, compressor or turbine by a new, individually tested sub-assembly. The design life of the hot parts is 1,000 hr and of the remainder, 2,000 hr.

Flight trials began in July 1954, in a Varsity, and a 150-hr rehearsal type-test, at the NEL1 rating, was successfully completed at the first attempt later last year. Further flying is shortly to take place with a Convair 240 and an Ambassador. Meanwhile, development is taking the Eland to higher ratings. The NEL1 is being taken to NEL2 (3,250 e.h.p.) and NEL6 (3,500 e.h.p.) standards, and a new range of stronger Elands, with air-cooled turbine blading, makes possible the NEL4 rating of 4,000 e.h.p. and the NEL5 of 4,200 e.h.p. The latter engine is now running.

The photograph shows a very interesting version, designated E.151 (NEL3 rating), for the Rotodyne helicopter. An auxiliary compressor has been added at the rear (left-hand end in the photograph), driven through a Sinclair-type hydraulic coupling. At take-off this auxiliary compressor supplies air to the rotor tip-jets; the coupling is then drained of oil until all the power is transferred to the airscrew.



Napier Oryx NOr.1. Single-shaft turbo-gas-generator, with 12-stage compressor (mass flow 9.9 lb/sec, pressure ratio at maximum r.p.m. 6.0:1), five combustion chambers, two-stage reaction turbine (expansion ratio 3.14:1) and four-stage auxiliary air compressor (mass flow 5.1 lb/sec, pressure ratio 1.8:1). Maximum diameter, excluding collector and valve, 19½in; overall length, excluding accessories, 83½in approximately. Net dry weight, engine terminated at gas-collector delivery flange, 495 lb + 2½ per cent; non-throttling valve and expansion joint, 66½ lb. Maximum speed, 21,900 r.p.m.; direction of rotation (viewed from rear of turbo/compressor unit) left-hand; total gas delivery under take-off conditions, 14.4 lb/sec.

Oryx Embodying one of the smallest axial compressors yet built, the Oryx is a gas-producer for helicopter propulsion. Air is taken in at an annular intake behind the engine accessories, and passes through the axial compressor, five tubular combustion chambers and two-stage turbine. The hot gas behind the turbine is then ducted upwards through a bifurcated volute. A second flow of air is induced at the other end of the engine, and, after passing through the auxiliary compressor, is likewise ducted upwards through a passage which surrounds the hot-gas volute. The flows then mix to provide a delivery at about 678 deg K and 23.5 lb/sq in abs., suitable for a helicopter rotor tip-jet. A large non-throttling valve is provided to assist in starting, and a non-return valve is also included in the aircraft system so that a twin-engined helicopter can fly on one unit.

At the first NOr.1 rating, of 750 gas h.p., the Oryx is shortly to fly in the experimental Hunting Percival P.74 helicopter. The next rating, of 825 g.h.p. in the NOr.4, is obtained at slightly higher r.p.m. (see data table on p. 407), and results in an engine with better specific fuel consumption and higher output, yet which weighs no more than the NOr.1. Such engines will be used in any future Hunting Percival helicopters, such as the P.105.

There are also other Oryxes, which are not yet cleared from security classification. Among these, the NOr.2 and NOr.10 may be mentioned, the latter having a rating of 1,250 g.h.p. and the former having a shaft drive of 700 h.p.

Gazelle At the time of writing very few details of the Gazelle are permitted for publication. It has been announced as a shaft-driving engine with a maximum output of 1,260 s.h.p. at the NG.1 rating. It has been unofficially linked with the Oryx, and certainly an airscrew- or rotor-driving version of the later types of Oryx would develop power of this order.

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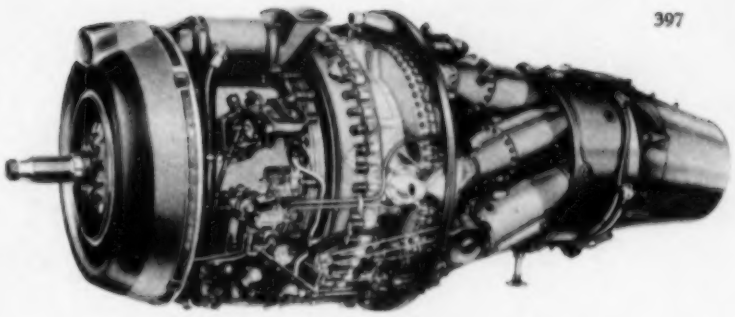
Dart First engine designed as a turboprop ever to fly, the Dart, although rudimentary in conception, has become deservedly successful. It is today the only gas turbine carrying fare-paying passengers, and in advanced forms—giving roughly twice its original design output of 1,000 h.p.—it will be seen for many years to come.

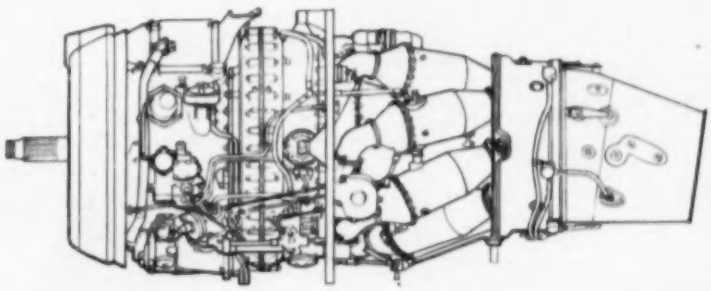
Lack of axial experience weighted the odds in favour of two-stage centrifugal compression (*à la* Merlin) when the Dart was projected. Both stages are driven by the two-stage turbine, which also supplies power to the reduction gear and airscrew. The first production version, at RDa.3 rating of 1,400 s.h.p. (1,547 e.h.p.), has now been very widely used in Viscounts, and has almost logged one-half-million hours in the air. These engines are designated Dart 505 or 506. All have shrouded turbine blades, high-energy ignition, water-methanol injection for restoring full power in tropical take-offs, and a host of detail refinements to improve overhaul and ultimate life. The overhaul life is at present 1,200 hr.

The 506 has several refinements of its own, aimed at improving efficiency rather than at an increase in output. Compressor efficiency, for example, has been raised by thinning-down and polishing the rotating guide vanes to each stage, and guide-vane modifications have also raised turbine efficiency. The cruising s.f.c. has thus been reduced to 0.655, from 0.68 in the 506.

Later Viscounts will have the Dart 510, which has a revised helical reduction gear capable of transmitting the greater power (see data table, p. 407). This engine also has numerous detail refinements. Even this is by no means the ultimate Dart, since the chief executive of B.E.A. has spoken of a Dart RDa.7, with a mass flow of 22 lb/sec and a maximum output of no less than 2,268 e.h.p. (cruising, 1,307 e.h.p.) and with an s.f.c. of 0.5 lb/hr/e.h.p.



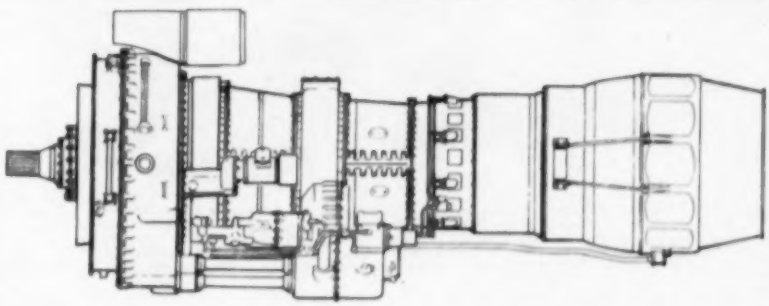
Rolls-Royce Dart 510 single-shaft turboprop. Two-stage centrifugal compressor, seven combustion chambers and two-stage turbine. Overall diameter, 28in; length, 97in; dry weight, 1,110 lb; mass flow, 20 lb/sec; pressure ratio, 5.5:1; maximum power, 1,600 s.h.p. plus 370 lb thrust (1,742 e.h.p.) at 14,500 r.p.m. with s.f.c. of 0.689 lb/hr/e.h.p.



R.B.109 It is a fair comment that experience counts in the development of a civil turboprop at least as much as it does anywhere else. The R.B.109 should, therefore, be an outstandingly good engine.

As the drawing (and this is of a provisional nature) shows, the two-spool compressors are extremely small and leave plenty of room for engine accessories within the confines of a cowling scarcely any bulkier than that needed for a Dart. Light alloy is the main structural material right back to the "hot" parts, and the weight is probably lower than that for any other engine of such power. The annular oil tank is integral with the intake casing, the oil-cooler unit being above.

A considerable amount of component running has been completed and, according to a recent lecture by Mr. Peter Masefield, the engine ran as a unit in May of this year.

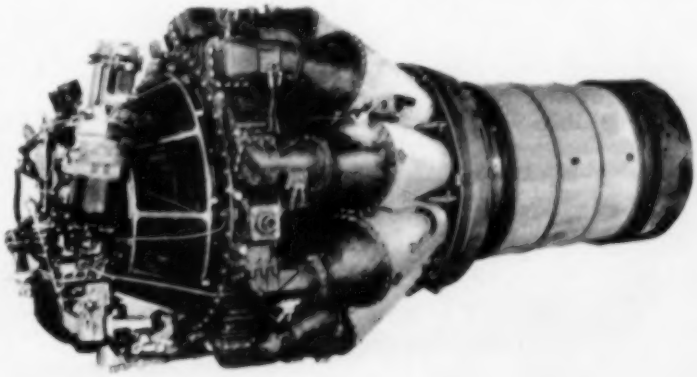


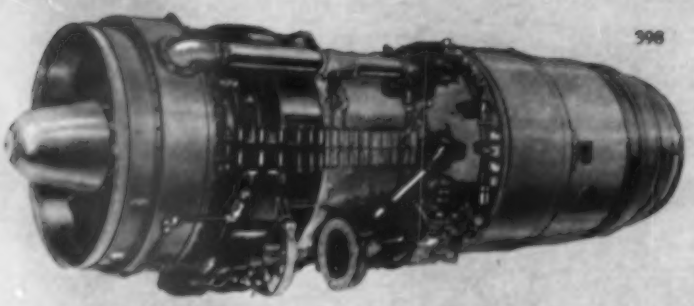
Rolls-Royce R.B.109 two-spool turboprop. Low-pressure axial compressor, high-pressure axial compressor, annular or cannular combustion system and two sets of turbine stages. Overall diameter, about 32in; length, about 115in; dry weight, about 1,900 lb; mass flow, 41 lb/sec; pressure ratio, not stated; maximum power, 4,020 s.h.p. plus 1,000 lb thrust (4,400 e.h.p.) with s.f.c. of about 0.41 lb/hr/e.h.p.

Centrifugal Turbojets After 10 years, Derwent production is tapering off, although these 3,600-lb-thrust engines are used in all parts of the world and will continue to need spares for some years to come. The Nene, on the other hand, is still in full production.

The most important Nene is the Sea Hawk engine, illustrated here. In this aircraft the jet pipe is bifurcated behind the turbine discharge casing and the propelling nozzles are positioned on each side of the aircraft. The engine has a cartridge starter, with multiple breeches (visible at the front of the engine), and is proving satisfactory in the arduous routine of carrier service. The other Nene in production is the Mk 10, with an electric starter. This engine is installed in the Canadair-built T-33AN Silver Star jet trainer. Most Nene 10s were built at Derby, but a proportion have been built by Rolls-Royce, Canada, as noted last week.

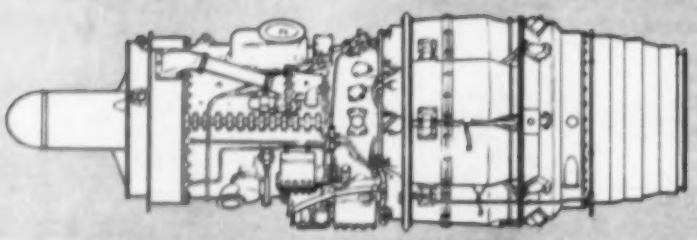
Rolls-Royce Nene 101 turbojet. Single, double-sided centrifugal compressor, nine combustion chambers and single-stage turbine. Overall diameter, 49.5in; length, 78in; dry weight, 1,618 lb; mass flow, 88 lb/sec; pressure ratio, 4:1; maximum thrust, 5,000 lb at 12,500 r.p.m. with s.f.c. of 1.085 lb/hr/lb.





Above: Rolls-Royce Avon RA.28 turbojet. Axial compressor, annular combustion chamber and multi-stage turbine. Overall diameter, 41.5in; length, 113in; dry weight, 2,890 lb; maximum thrust, 10,000 lb rated, with s.f.c. of 0.86 lb/hr/lb.

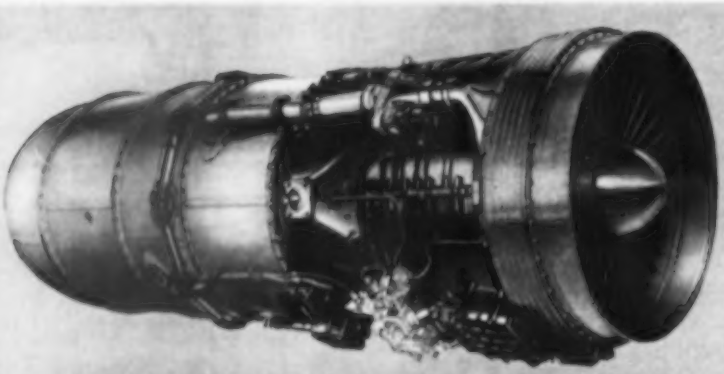
Below: Rolls-Royce Avon RA.7 turbojet. Twelve-stage axial compressor, eight combustion chambers and two-stage turbine. Overall diameter, 42.2in; length, 102.1in; dry weight, 2,460 lb; maximum thrust, 7,500 lb at 7,800 r.p.m. with s.f.c. of 0.92 lb/hr/lb.



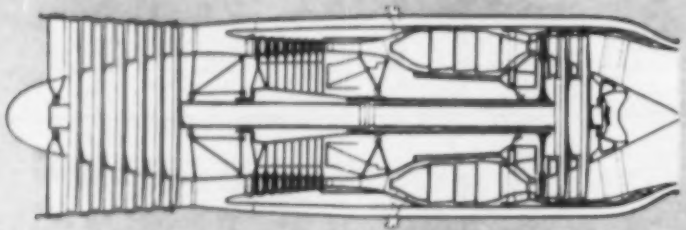
Avon Under this name has been established the widest range of military and civil gas turbines in the world. The first production rating was 6,500 lb, and this range of Avons began to flow from Rolls-Royce—and, later from Bristol, Napier and Standard Motors, as well as from Commonwealth Aircraft in Australia—in 1950.

In 1952, the RA.7 (see drawing) went into production at a rating of 7,500 lb. In these engines, full all-weather protection and triple-breech turbo-starters were introduced, and—in spite of strengthening to meet the needs of transonic flight—the thrust/weight ratio was improved. Engines of this family have now been built in large numbers, a proportion having an afterburner to boost the maximum thrust by 2,000 lb. The RA.21 is the latest production engine of this series, with a rating of 8,000 lb thrust, at slightly higher r.p.m.

A considerable advance was made with the introduction of the RA.14 (see data table, p. 407), in which higher compression, and other modifications, made possible the achievement of significantly greater thrust and better specifics. Engines of this type were actually being delivered two years ago, and a number of related units have since been evolved, including the RA.28 illustrated. All these later Avons have an annular combustion system in order to accommodate the increased mass flow, while actually reducing the overall diameter.



Rolls-Royce Conway by-pass turbojet. Large-diameter low-pressure compressor, small-diameter high-pressure compressor, annular combustion system and two sets of turbine stages. Maximum type-tested thrust, 13,000 lb, with very low specific fuel consumption. **Note:** The diagram below is not intended to portray the Conway, but has been prepared by Rolls-Royce in order to clarify the operation of a by-pass engine.



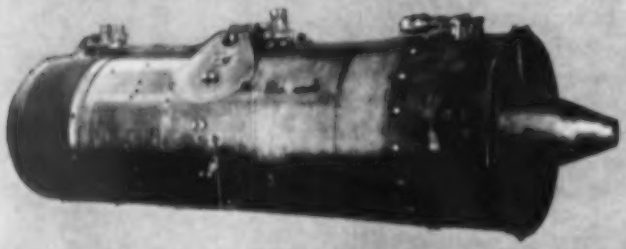
Conway Culminating many years of patient toil is the announcement of a type test of the Conway at 13,000 lb thrust, with the lowest specific fuel consumption of any type-tested turbojet.

In this remarkable engine, the excess delivery from an oversize low-pressure compressor is passed around the outside of the engine and re-enters the jet stream aft of the turbine section. The remainder of the compressor delivery passes through a smaller, high-pressure compressor, combustion system and turbines, and is expelled as a propulsive jet through the centre of the by-pass flow. By this means, the mass flow is increased (compared with a simple turbojet burning fuel at the same rate) and the mean jet velocity reduced, so improving the propulsive efficiency and reducing both the specific consumption and the noise level. Installation and fire problems are also eased by the cool air flow which surrounds the engine.

The accompanying photograph, the first to be released of an actual Conway, shows the engine (in this particular form, at least) to be not dissimilar in appearance to a normal turbojet. Some indication of the enormous mass flow through the low-pressure compressor is given by the length of the inlet guide vanes. Other features of interest are the duplex fuel supply to nine or ten burners and the pipe leading hot air from the high-pressure diffuser, through an electrically actuated gate-valve, to anti-ice the front of the engine.

Various Conway ratings have been published, the latest being RCo.2, 3 and 5, but no details of these engines may be published. Flight trials are progressing with a modified Ashton, and four Conways will take the Vickers 1000 transport into the air before many months have passed.

Below: Rolls-Royce Soar RSr.2 turbojet. Single axial compressor, annular high-intensity combustion system and turbine. Overall diameter, 15.8in; overall length, with exhaust cone, 58.9in; dry weight, 375 lb; maximum type-tested thrust, 1,810 lb at high r.p.m. with s.f.c. of 1.27 lb/hr/lb.



Soar When it was first revealed to the public one year ago the RB.82 Soar had a far better thrust/weight ratio and thrust/frontal area ratio than any other gas turbine, and there has since been no announcement of any unit to challenge it. Although it clearly has immense importance as an expendable engine it does not follow that all Soars are lifed at 10 hr only. Versions have been developed for a number of applications, and it is worth remembering Rolls-Royce work in the field of vertical take-off, which will require a lifting jet described as "a distant cousin" of the Soar.

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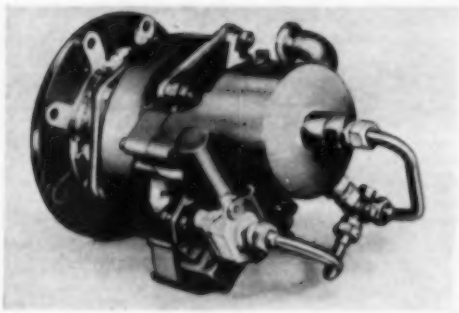
ACCESSORY DEVELOPMENTS

de Havilland cold-air unit.

EACH year it is our custom to review in this issue new developments by the British companies responsible for the more complex types of airborne accessory—such items as air-conditioning equipment, power systems and control devices. Never before, even during World War 2, has such work occupied so large a section of industry, for a modern fighter or transport absorbs hundreds of such units, worth many thousands of pounds. Every item has to work efficiently, precisely and reliably, notwithstanding the fact that it may get very hot, very cold, or be shaken violently; furthermore, everything has to fit into the smallest possible space while remaining easily accessible for servicing or replacement.

Many components have to be specially tailored for a particular installation, and the number of people involved in developing and producing such equipment actually exceeds that employed in the manufacture of airframes. No fewer than 287 "accessory companies" are this year exhibiting at the S.B.A.C. Show. This is a record number, and it reflects the healthy state of our great industry.

Nearly all the items described on the following pages will be available for inspection at Farnborough; further progress reports, together with accounts of electronic, radio and radar developments, will appear in subsequent issues. Addresses of firms mentioned below will be found in the address section on pp. 424-428 of this issue.



B.T.H. liquid-fuel (i.p.m.) turbine starter.

The Airscrew Company and Jicwood, Ltd. Development and production is proceeding upon all kinds of fans, the majority being in wood, although the company are also delivering fans for special purposes in which the material is of even lower density. Both axial and centrifugal patterns are in production for aircraft ventilation purposes, and the company also make fans for wind tunnels (as well as complete low-speed tunnels) and for demonstration tunnels for instructional or test purposes.

Automotive Products Co., Ltd. To the well-known range of Lockheed-Avery flexible pipes and self-sealing couplings have been added several new lines. One of these is known as the Type 15 hose, and is suitable for use with high-temperature fuels and synthetic lubricating fluids. Another type of hose has been specifically designed for use in high ambient temperatures, and constitutes a new range of fire-resisting equipment.

Self-sealing-coupling developments include the super-high-pressure coupling, suitable for all aircraft fluids and capable of accepting pressures as high as 5,000 lb/sq in. Bore sizes range from $\frac{1}{2}$in to $\frac{1}{2}$in at present. Another improvement is a quick-acting coupling, without a screwed union, joined by sliding sleeves or a spring-loaded bayonet union. When broken, the fixed portion of the coupling can be hermetically sealed by a blanking cap.

Belling and Lee, Ltd. Specially developed for 30-V circuits, the L.1330 fuse is being manufactured in ratings from 35 to 275 amp for direct bus-bar mounting. This fuse-link is already widely used in the U.S.A. and is expected soon to be in service on the Viscount and other British aircraft.

The familiar general-purpose fuse-link L.1055 is now being manufactured by an entirely new technique, which bonds caps, glass and filament into one unit, caps being so securely held that they cannot be twisted off without fracturing the glass. Heavier ratings in this range for low-voltage applications are now made with strip-type elements which will withstand considerable vibration.

British Messier, Ltd. One of the most recent undercarriages to be designed by this company is that for the forthcoming Bristol 191 anti-submarine helicopter. The installation comprises four fuselage-frame members each mounting a vertically held oleo-pneumatic shock absorber. The wheel fork is of the usual castoring type, but it incorporates a special hydraulic lock to prevent this action when the parking brake is on. Another hydraulic lock is incorporated which prevents the leg from telescoping beyond the static equilibrium position when the helicopter is parked on a vertically accelerating surface (such as the deck of a carrier).

A new hydraulic pump is the model 4839, a high-speed, lightweight unit which can be driven either electrically or by an air turbine. The operation is by swash-plate and plunger, and a small centrifugal pump is included which pre-pressurizes the incoming fluid to 40 lb/sq in. By this action, the pump is primed and the delivery pressure raised to 4,000 lb/sq in. The shaft input can be at up to 10,000 r.p.m., this speed resulting in an output of 15 cu in/sec.

A third new development is a nose-flap actuator for a large, near-sonic aircraft. Very rapid flap actuation is required, and an accumulator supplements the normal power supplied to the jack, which is itself very large.

The British Thomson-Houston Co., Ltd. Major new development by B.T.H. is a monofuel starter. In its earliest form this system required electrical power, not only to provide heat for ignition but to pump the fuel (iso-propyl nitrate) and to pressurize the unit to initiate combustion. In the new B.T.H. starter, a fuel injector resembling a small liquid-fuel cartridge is incorporated, holding just sufficient fuel for one start, restrained by a spring-loaded piston. The start is initiated by a small cartridge, mounted remote from the starter in an accessible position, which provides both heat and pressure and, acting on the piston against the spring, forces fuel into the combustion space.

Engagement between the starter coupling and the engine is gentle, being made before full power or torque is developed; further, as only enough fuel for one start is available at any time, any failure leads to safe conditions. The total electric current required does not exceed one ampère; B.T.H. also calculate the system as being some 30 per cent lighter than other similar equipment. It is going into production for the Sapphire-powered Javelin.

High-energy ignition units, operated off the normal 24-V D.C. supply, have been designed for various gas turbines. They are suitable for operation at altitudes up to 55,000ft and between temperature limits of −50 to 100 deg C; special units are now also being developed for ambients of 150 deg C. Other developments continue in the field of electric motors, ranging from large units for flying-control systems to very small induction motors used in radar servo-control circuits and in small blower units.

de Havilland Propellers, Ltd. A new airscrew already in service is a two-bladed Hydromatic, constant-speed, feathering unit for the Heron. Previously the Heron was fitted with the well-known non-feathering bracket-type airscrew, and the new unit is offered as an alternative. It has a fibre-glass spinner and fluid de-icing, and involves a weight penalty of less than 25 lb.

Considerable development has also been completed upon cold-air units for cabin air circuits. Under Hamilton Standard licence, de Havilland Propellers have in production cold-air units suitable for the most advanced types of civil and military aircraft. Used in conjunction with a heat exchanger, these units can reduce the temperature of compressor-bleed air by more than 300 deg C; two of the standard sizes have deliveries of 30 and 80 lb of refrigerated air per minute. This company are one of the leaders in the development of guided weapons, but little of this work can yet be made public.

Accessory Developments...

Delaney Gallay, Ltd. A new fuel-cooled oil cooler for gas turbines has now been successfully used on type test, and is illustrated here. Entirely of light-alloy construction, the new unit can be tailored to fit any available space and to withstand the high fluid pressures common to most modern engines. Overall heat-transfer characteristics in this heat exchanger have been improved by a new method of secondary surfacing.

Newest of the company's air/air heat exchangers are of the primary surface tubular type, the design providing for ready replacement of damaged tubes. The latest cabin-air heater is a gas/air unit designed to replace part of a piston-engine exhaust collector ring. Special precautions ensure that the cabin air cannot be contaminated, and helicopter applications are envisaged.

Dowty Equipment, Ltd. There are four "aeronautical" members of the Dowty Group, the main member heading this paragraph being backed up by Dowty Fuel Systems, Dowty Seals and Dowty Equipment (Canada), the last-named having been discussed in our last issue. A new product by Dowty Equipment is a 14-cylinder hydraulic pump which is, in effect, a doubled-up version of the well-known Vardel pump. Although the two 7-cylinder units are mounted in tandem (with a high-output gear-type booster common to both in the first stage), all the control mechanism has been positioned underneath, thereby reducing the overall length to no more than 1.34in greater than the standard Vardel. The Double Vardel can thus be mounted in the annular space between an engine and its cowling, and multiple units can be mounted on the side of a gearbox.

Another new development is a hydraulic motor, and the Dowty three-position magnetic indicator, illustrated, is a recent product now in full production. The latter gives three indications on a flat ¼in face and weighs under 2¼ oz.

Dowty Fuel Systems have recently produced two new single-circuit fuel systems, with spill burners, for turbojets. These are considered to indicate the future trend of fuel-system design. Undercarriages have been developed for such aircraft as the Hunter, Javelin, Vulcan, Friendship, Mach-Trainer and (by the Canadian company) Avro CF-100.

Dunlop Rubber Co., Ltd. Tubeless tyres are now being developed for all types of aircraft. An extensive range of new pneumatic components has also been prepared, including bottles made of resin-impregnated glass-fibre.

Dowty magnetic indicator.

It should also be recorded that a considerable amount of development and production of special materials and small products for the aircraft industry is now being done by Dunlop Special Products, Ltd., and also by Xetal, Ltd., a Dunlop subsidiary.

Electro-Hydraulics, Ltd. Typical of the new hydraulic installations engineered by this company is that for the Herald. Two fixed-delivery engine-driven pumps supply a pressure of 3,000 lb/sq in for the undercarriage, flaps, brakes and nosewheel steering. Flap actuation is by one jack on each surface, with mechanical synchronization. A separate emergency circuit is provided for lowering flaps and undercarriage. Nosewheel steering is so arranged as to suppress shimmy and to ensure that the unit is centred before it is retracted; the complete nose unit, less wheels, is illustrated at the foot of p. 401.

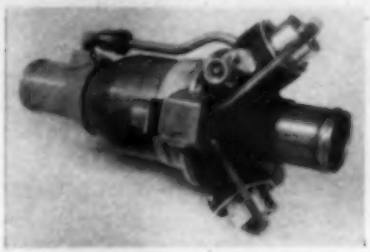
The undercarriage units are light-alloy forgings. In spite of the fact that the Herald is a high-wing aircraft, with 9ft between the wing and the ground, the weight of the entire undercarriage is only 4.47 per cent of the maximum weight of the aircraft (33,500 lb) in the prototype; Electro-Hydraulics expect to be able to achieve 4.26 per cent in production. Of this, 1.91 per cent is accounted for by the wheels, tyres and brakes.

There are also several entirely new hydraulic and pneumatic components, including various solenoid valves and a small electrically driven hydraulic power unit for operating light hydraulic mechanisms.

The English Electric Co., Ltd. Very considerable effort is being applied to the development of paralleled alternating-current power systems, using variable-ratio hydraulic drives manufactured under licence from the American Sundstrand company. One of the standard units has a drive rated at 50 h.p. (continuous) and is associated with the Type 918 alternator. This equipment, which was designed primarily for this hydraulic drive, provides an output rated at 40 kVA with a frequency of 400 cyc/sec ± 1 per cent. A six-pole exciter is employed, the brushes being suitable for operation at high altitudes. The unit is blast cooled at the rate of 120 cu ft of air per minute at 6in water gauge pressure. The Type 918 alternator weighs 98 lb and the Sundstrand drive 78 lb.

One of the most important new rotary machines is a D.C. generator with a wide speed range. Intended for 28V systems, it can deliver a full output of 300 amp over a speed range of 2,850 to 10,000 r.p.m. at all altitudes up to 50,000ft. The weight is 82½ lb. New D.C. generators of various types are under development, two models having continuous ratings of 40 watts at 11,000 r.p.m. and 35 watts at 9,000 r.p.m., respectively.

Very widespread development has also taken place in the design of other types of rotating machinery, circuit breakers, transformers and electric actuators.



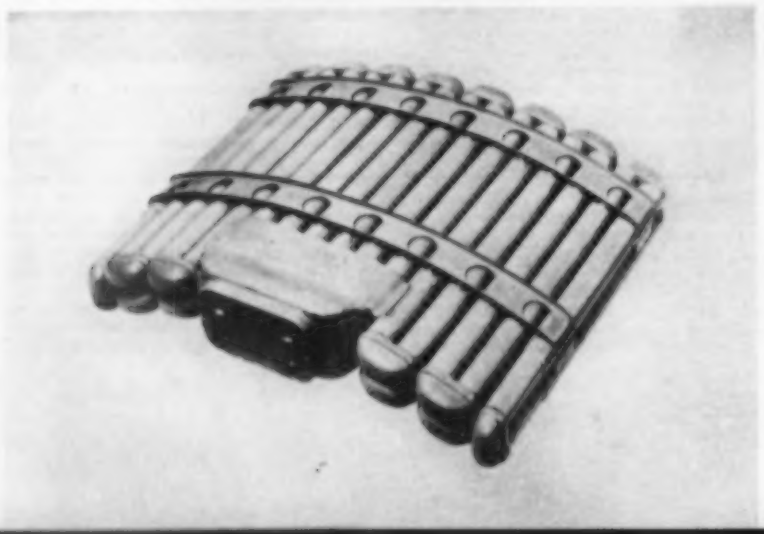
Flight Refuelling Mk 19 in-line valve.

Flight Refuelling, Ltd. One of this company's latest ancillary products is the Mk 19 on/off-loading valve. This is an in-line valve capable of passing 150 Imp. gal per minute, and it is electrically controlled with solenoid operation. An override delivery line is incorporated which enables selection to be made without electric power, as might be the case during defuelling.

A new range of screw-type non-return valves has been developed, incorporating the good sealing characteristics of the earlier spun-body non-return valve. The new valves are claimed to be considerably lighter and more compact than any other comparable equipment. The Mk 9 transfer valve is a recent development, originally for light fighters, suitable for both pressure fuelling and transfer. In the latter function it can accept flow rates up to 400 gal/hr with low pressure loss; for refuelling, no less than 50 gal/min is possible. The length is three inches and the weight under half a pound. Another new development of the Mk 9 is the Mk 10 tank shut-off valve. This unit fits inside a tank and has a solenoid and leak-proof electrical connections which can be made or broken inside the tank. Designed for normal flow-rates up to 50 gal/min, the Mk 10 is less than half the size of existing types and approximately one-third the weight.

Girling, Ltd. An important and advanced line of development has now started, with the design of a range of anti-flutter dampers for various types of high-speed aircraft. Although of considerable significance, these dampers are a very recent development, and specific details are still withheld. It can, however, be

Delaney Gallay fuel/oil heat exchanger.



So strong . . .

no one

will

dare

attack us

SIR THOMAS SOPWITH

Here in Britain we have come to think of freedom as part of our birthright. But the hard truth is that freedom is never free. It has to be built on a solid bedrock of security and there is only one way to build it. That is to stay strong enough to look after yourself and to help others. Today, air power is vital to this task. In fact our whole future as a free people may depend on the extra margin of efficiency possessed by our aircraft and aero engines. This is the inescapable truth of our present situation. This is what makes the work of the Hawker Siddeley Group of Companies of fundamental importance to Britain.

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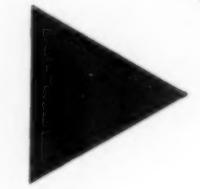
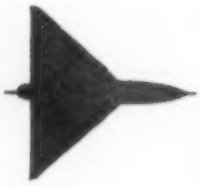
This, the world's first 4 jet delta bomber, is now in full production for the Royal Air Force. Its basic simplicity will keep it abreast of aeronautical progress for years to come. The Vulcan is a product of the famous Avro tradition of co-operation, planning and genius for large-scale production. One of the most important factors about the Vulcan is that as new and more powerful engines are developed, it will be possible to fit them without any basic structural alterations.

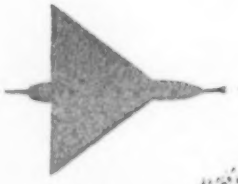
FORGING AHEAD OF TIME

Today the Community of Europe is a matter not only of policy but of necessity. The fate of all free peoples is linked with the fate of Europe – whose freedom depends first and foremost on the superiority of Western air power. Once again, therefore, all eyes are on the display of British air achievements at Farnborough – where the aircraft of the Hawker Siddeley Group of Companies again take pride of place. Four major new aircraft of the Group are now well into the stage of quantity production. The Sea Hawk and super-priority Hunter are pouring out of Group factories for the R.A.F. and NATO. Other super-priority types – the Vulcan and the Javelin – follow close behind. Group companies have a long line of successes to their credit. Let us remember the 45 years of aviation pioneering which lie behind the great aircraft which will thrill the world's onlookers during the Farnborough Display.

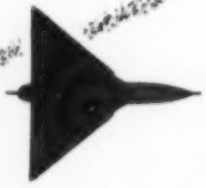




AVRO 707 A



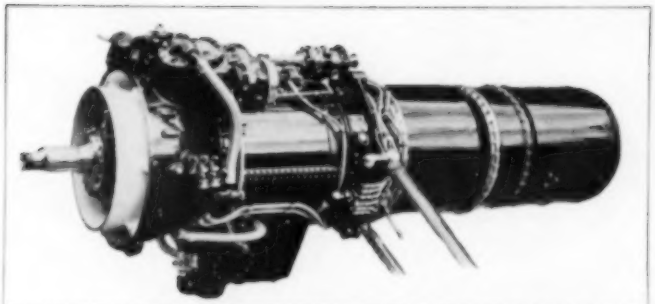
AVRO 707 B



AVRO 707 C

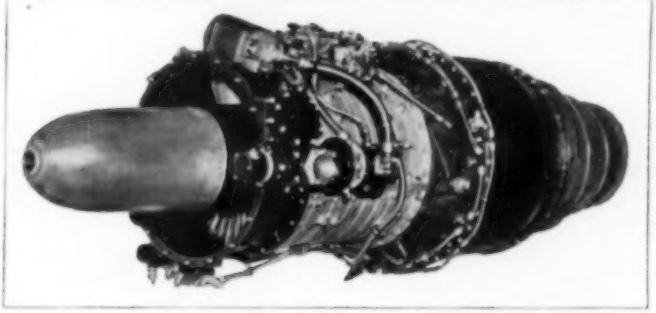
HIGH SPEED TOWED TARGET

The Air Service Training C4 towed target is a metal covered target designed for operation at high speeds. Basically all wing, a body is included for sighting at high altitude and the body houses equipment and mechanism. Still in the development stage, great interest is evident in this project, designed and built by Air Service Training Limited, Aircraft Division, who also manufacture aircraft components and a wide range of aircraft toilet servicing equipment.



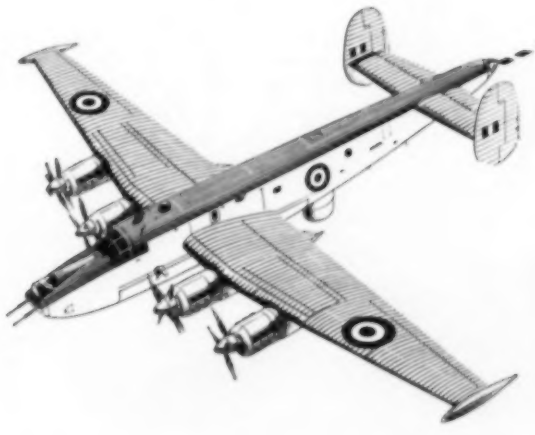
ARMSTRONG SIDDELEY MAMBA

This compact, highly efficient turbo-prop is in production for naval aircraft, and the latest version—the Mamba 7—is under development for civil use. The Mamba powers the Short Seamew light anti-submarine and coastal reconnaissance aircraft. It is also being produced in quantity in its dual form, the Double Mamba.



THE VIPER

The Viper is the world's first lightweight jet engine in production for widely different aircraft. Two Vipers power the rocket-boosted SO Trident—first to fly supersonic on the climb—and a single Viper gives pupil pilots jet power combined with foolproof handling in the RAF's Jet-Provost trainer. Re-heat for the Viper, increasing its thrust from 1640 to 2470 lb., is under development in Britain and France.



AVRO SHACKLETON MARK 3

Now in production for the R.A.F. and South African Air Force, the Shackleton Mark 3 is the most powerful sub-hunter in the world. Its sensitive search and detection apparatus alone accounts for nearly 1½ tons of equipment. A great variety of bombs, depth charges and mines can be carried in its very large bomb bay, and in its air/sea rescue role it can also drop, by parachute, a large fully-equipped, motor-driven lifeboat.

HAWKER SIDDELEY GROUP

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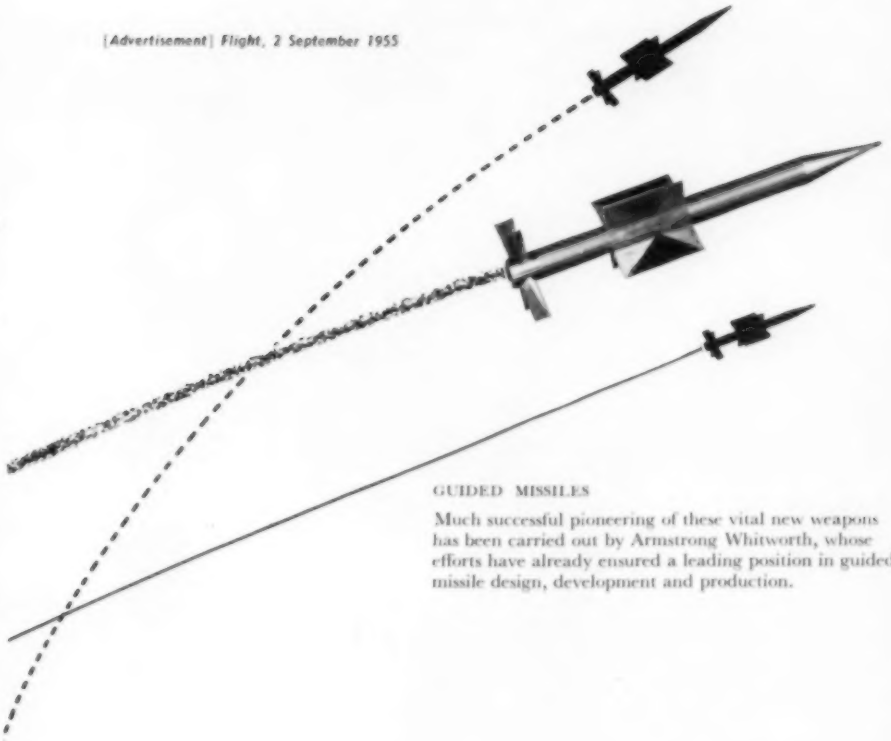
PIONEER . . . AND WORLD LEADER IN AVIATION

GLOSTER JAVELIN

Day and night, fair weather or foul, the Gloster Javelin can be up at 50,000 ft. and ready for action a few minutes after take-off. Powered by twin Armstrong Siddeley Sapphires, this long range fighter will be Western Europe's first line of defence against high level, high speed Atomic attack. The Javelin will also carry the new Air-to-Air guided missiles now under development.

SEA HAWK The Fleet Air Arm packs a bigger punch now that the Sea Hawk is in squadron service. In full production by Armstrong Whitworth for the Royal Navy and NATO, the Sea Hawk is easy to handle, easy to land on deck, and in fact the most efficient carrier-borne fighter in the air today.



GUIDED MISSILES

Much successful pioneering of these vital new weapons has been carried out by Armstrong Whitworth, whose efforts have already ensured a leading position in guided missile design, development and production.

HAWKER HUNTER

The largest production programme in Western Europe since World War II has been concentrated on the Hawker Hunter where they already form the backbone of Europe's Defence System. Hunters have been ordered in quantity for the R.A.F., NATO, Holland, Belgium, Denmark and Sweden, and are being manufactured under licence in Holland and Belgium. Besides its interceptor rôle the Hunter is now being developed as a Ground Attack Fighter, Long Range Interceptor with drop tanks and the Hunter Two-seater which recently took the air.

POWER IN THE AIR

The shape of aircraft is rapidly changing. The new breeds of aircraft in the air today represent a radical departure from previous types. The patterns we shall see flying about the skies in the not so distant future, will be different from these we know now. To meet these changes the policy of the Group is one of steady expansion and progress in which the work of our scientists and technicians becomes ever more important.

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MALTON PLANT

In two of the most modern factories anywhere, covering a total of nearly two million square feet, on 350 acres at Malton, Ontario, some 14,000 Canadians are making a significant contribution to the defence of the free world. This picture shows the production plant of Orenda Engines Limited. Close by and adjoining the Malton airport are the production and engineering facilities of Avro Aircraft Limited. Both companies are members of the A. V. Roe Canada Group.

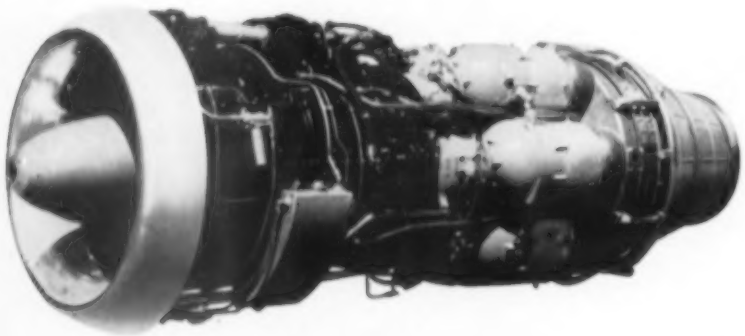
AVRO C.F.100

This All Weather interceptor will shortly become part of the NATO Defence System in Western Europe. It is already the standard All Weather Fighter for the R.C.A.F. Powered by the Orenda Gas Turbine Engine – another product of the A. V. Roe Canada Group – the C.F.100 has become one of the world's outstanding All Weather Interceptors.

THE PRECISION

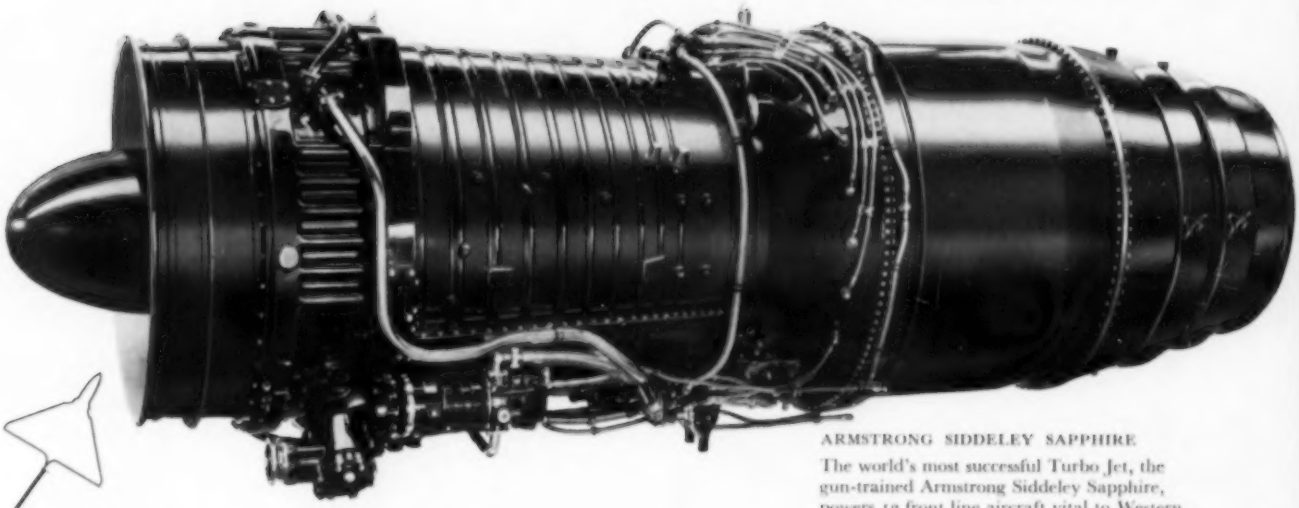
INSTRUMENTS OF

DEFENCE



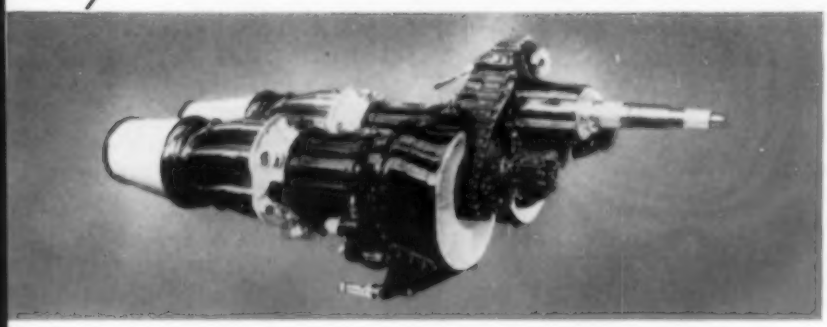
ORENDA

In just three years from a brand new plant, 2,500 Orendas have been built. This outstanding jet engine is the power plant that makes the C.F.100 Long Range All Weather Interceptor and the Sabre 5 and 6 Fighters outstanding amongst front line aircraft. Daily, the Orenda is proving its leadership in R.C.A.F. bases in Canada and Europe.



ARMSTRONG SIDDELEY SAPPHIRE

The world's most successful Turbo Jet, the gun-trained Armstrong Siddeley Sapphire, powers 13 front line aircraft vital to Western Defence ; the Hawker Hunter F.2 and F.5, the Gloster Javelin, the Handley Page Victor and the English Electric P.1. It also powers 1 French, 1 Swiss and 7 American types.



DOUBLE MAMBA

In large-scale production by Armstrong Siddeley Motors, the Double Mamba provides twin-engine safety and single-engine economy in one power plant. Versatile and rugged, the Double Mamba installed in the Fairy Gannet Anti-submarine aircraft is in squadron service with the Royal Navy and deliveries are being made to the Royal Australian Navy. Two new versions, the ASMD 3 and the ASMD 4 can now be mentioned although details are still secret.

The Hawker Siddeley Group of Aircraft Companies forms the largest British organisation engaged in the design and construction of aircraft, aero-engines, gas turbines, rockets, guided weapons and missiles. The unquestioned excellence of aircraft and aero-engines designed and perfected by Group Companies is freely acknowledged by aeronautical experts all over the world. The Group is not only famous for the daring efficiency of its original designs – it is also famous for getting them into quantity production *fast*.

HELICOPTER TRAINING

At Air Service Training's flying school at Hamble, pupils from 71 countries have been trained for air crew and maintenance duties in all types of aircraft. Since 1939, some 44,000 Air Force and Civilian students have been trained in flying, navigation, aeronautical engineering, radio and radar. The latest addition to this "University of the Air" is a helicopter training unit. Now more than ever, Hamble will be the stepping stone to success for the airmen of tomorrow.

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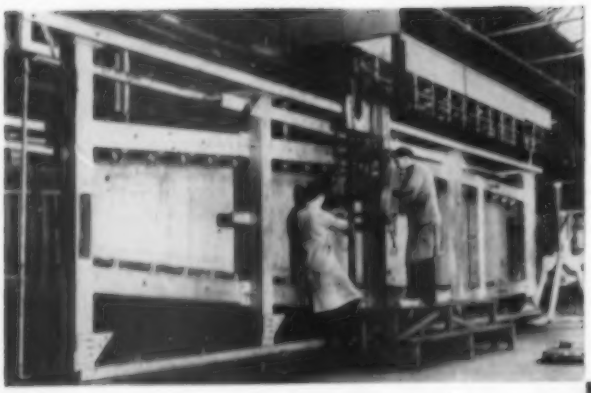
PIONEER . . . AND WORLD LEADER IN AVIATION

Why Pioneer...

and World Leader?



PRODUCTION The big problem in producing modern aircraft in quantity is 'tooling up'. Illustrated above is one of the jigs essential in large-scale production. For example, over 40,000 jigs and tools were designed and installed for the quantity production of the Avro Vulcan. This is in fact a production story *behind* the production story.

Over 70,000 skilled workers, technicians and aeronautical engineers staff a network of Group factories which spread out from England, Scotland and Wales to Canada and Australia. This great Group of co-ordinated companies has been charged with the responsibility of designing and constructing the new aircraft, engines, rockets, guided weapons and missiles which form our prime defence today. Nearly everything the Group makes is 'news'. Among the famous jet aircraft and engines you have already read about in your newspaper are the fast, easily manoeuvrable Hawker Hunter, the gigantic Avro Vulcan, the all-weather Gloster Javelin and the 'gun trained' Armstrong Siddeley Sapphire – world's most successful jet turbine. These famous names and other projects too secret to mention are the expensive necessities of freedom today.

RESEARCH Armstrong Whitworth's new 10,000 h.p. Mach 3 Wind Tunnel will provide Hawker Siddeley Group and Britain's aircraft industry with a unique research facility. It is capable of speeds between Mach 0.3 and Mach 3 and will be used for research into the newest problem in aviation – "the heat barrier". One of the main features of this tunnel is its ability to operate continuously for almost unlimited periods throughout its speed range.

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PIONEER . . . AND WORLD LEADER IN AVIATION

A. V. ROE · GLOSTER · ARMSTRONG WHITWORTH · HAWKER · ARMSTRONG SIDDELEY · HAWKSLEY · BROCKWORTH ENGINEERING

AIR SERVICE TRAINING · HIGH DUTY ALLOYS · *and in Canada:* AVRO AIRCRAFT · ORENDA ENGINES · CANADIAN STEEL IMPROVEMENT

Accessory Developments...

stated that they are of the rotary type, and are accordingly installed axially in line with the hinges of the ailerons, elevators, rudder or other surface. Girling anti-flutter dampers are already being installed in the latest types of military aircraft.

Sir George Godfrey and Partners, Ltd. The equipment illustrated is the TF-10, one of the largest of the company's turbo-fan series of cold-air units, which can supply cooled air to the cabin even when the aircraft is at rest on the ground. The turbo-fan units now incorporate fabricated sheet-metal volutes, with considerable weight-saving. The TF-10 is used in the

Godfrey TF-10 cold-air unit.

Britannia. The company are also in production with many other types of cold-air unit, ground conditioning trolley, water extractor and other related equipment.

As a result of their considerable experience in the development of turbo-alternator sets, the company have now designed the Type TA-15, a direct-coupled unit with the turbine and alternator rotors both mounted on a common shaft. The alternator is a Rotax 15-kVA unit, and output frequency is controlled by an electronic circuit operating a hydraulic servo which actuates variable-area nozzles in the turbine. The alternator casing is pressurized by a fan mounted on the main shaft, the heat being rejected in a fuel/air heat exchanger surrounding the alternator. Oil for lubrication and servo operation is obtained from a Barske-type oil pump driven at 24,000 r.p.m. The entire unit, complete with frequency-control gear and a mechanical overspeed governor, weighs 120 lb.

The Goodyear Tyre and Rubber Co. (G.B.), Ltd. Although the wave-type wheel, developed by Goodyear, is used wherever possible on account of its high strength/weight ratio, the box type is sometimes preferable, and a new pattern, known as the bowl wheel, is being developed for certain applications. Broadly, the box wheel has the highest structural strength, the bowl wheel high fatigue resistance and the wave wheel intermediate properties.

Brakes currently in production include the flush type, in which the brake is housed entirely within the wheel, one such unit being made for the Republic F-84F. For the Viscount, the radical full-circle brake is in production, the usual group of pistons being replaced by a circumferential annular piston.

Goodyear wave wheel for Vickers 1000.

Development is proceeding upon various hydraulic systems for braking and other purposes.

H. M. Hobson, Ltd. A wholly new development is the Elliott-Hobson integrated control system. This system, which unifies the autostabilizer, auto-pilot and main power-control actuator, has been designed to provide the advantages of an electrical signalling system whilst retaining a mechanical linkage between the pilot's controls and the powered flying control. The linkage is used primarily as a reference for the correct functioning of the system and can also be brought in automatically to act as the control system in the event of failure. Among the attributes of this inherently safe system are a saving in weight, an improvement in stiffness, performance and handling characteristics, and, where a low-grade mechanical standby system is acceptable, development may be completed without having to consider structural feed-back effects.

A related system is the Hobson all-electric signalling control, which is designed to supersede the linkage between the pilot's controls and the flying control itself. The system features parallel triplication, which serves to render the circuit proof against any electrical failure. Control-surface movement proportional to stick deflection is obtained by amplifying the difference between the signals derived from pick-offs on the pilot's controls and the surface itself and then using the resultant to drive the two into coincidence.

The company continue to develop, and manufacture, a very considerable variety of powered flying-control units for all kinds of aircraft and guided weapons. Feel-simulation units and injection carburettors are other products, recent developments including a self-governing fuel control unit and a pressure-driven back-up fuel booster pump, both for pilotless aircraft.

The Hymatic Engineering Co., Ltd. The increasing use being made of compressor-bleed air is continually demanding increased performance from hot-air control valves. The established Hymatic PS48 and PS60 types have now been supplemented by the PS88 and 89. Passing up to 275 cu ft/min, the new units embody sleeve-valves which permit tolerances of $\pm 1\frac{1}{2}$ lb/sq in to be maintained over the entire flow-range. The PS88 maintains a constant absolute outlet pressure and the PS89 a constant differential pressure.

Extremely fine control of bottled h.p. gas has been achieved in the PS64 reducing valve. This unit maintains a tolerance of ± 3in water gauge on flows of 90 cu ft/min when reducing in two stages from 3,000 lb/sq in to 10in water gauge. The PS81 is a second stage in a 4,000 lb/sq in system, accepting air at from 10 to 15 lb/sq in. It maintains a reduced pressure at the outlet of 8 lb/sq in, and has a tolerance of ± 0.1 lb/sq in on flows up to 180 cu ft/min.

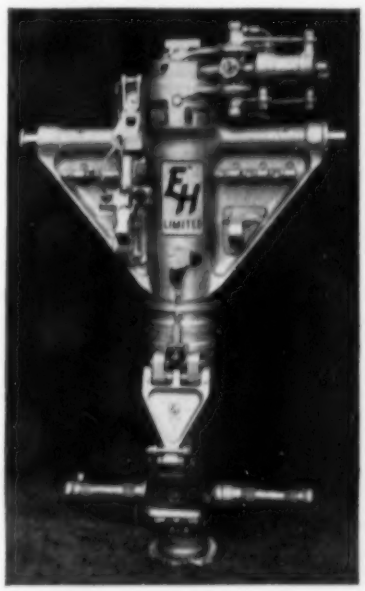
Another recent development is the multi-services connector, designated M.S.C.1. This provides an aircrew member with immediate connection to all his personal services inside the aircraft with a single "plug-in" movement. Disconnection is automatic, irrespective of whether exit is made by an ejection seat or not.

Integral, Ltd. A new departure for the company—which is an associate of H. M. Hobson, Ltd.—is the manufacture of a complete electronic fuel flowmeter system, under licence from Etablissements Fauré-Herman. The system comprises a transmitter which measures the flow by the free rotation of a helical rotor, an electronic relay which converts the transmitter signals into indications of rate of consumption and amount burnt, and a cockpit indicator giving both readings on a single face.

The rotor contains a magnetic insert in one of its blades, and this induces a series of signal pulses which are split into the rate-of-flow and totalizing circuits. Both circuits therefore give indications which are functions only of frequency and are thus independent of variation in supply voltage. Integral point out that this is one of the lightest and most compact installations of its type in the world, and that it can readily be inserted into existing fuel systems.

More well-established lines of development include several new hydraulic pumps and motors, one of which is the Type 215 motor/pump unit. This comprises a Type 167 hydraulic pump driven by a Type 199 swash-plate hydraulic motor, and is employed for emergency supply to a general hydraulic system in the event of failure of the normal pumps. The unit can also be adapted for use as a pressure intensifier. Other equipment includes the Type 184, a 14-cylinder radial-piston hydraulic pump with a capacity of 11 gal/min at 3,000 r.p.m., and the Types 148 and 216 motor/pump units, the latter being driven by A.C. motors and used to

Electro-Hydraulics nose leg for Herald.



Accessory Developments...

Kelvin Hughes generator for percentage tachometer (indicator illustrated, right).

energize the feel-simulation system of the Britannia.

Kelvin and Hughes, Ltd. Illustrated is the new percentage tachometer, together with its generator. Mounted in a 2in case, this instrument expresses engine r.p.m. as a percentage of the maximum, with an accuracy of within 0.5 per cent. With suitable gearing this instrument can be employed with any type of power unit, and it is already available from production. Another new instrument is a combined a.s.i. and machmeter; specifically designed for aircraft in which panel space is at a premium, it represents new thought in dial presentation. It is similar in action to a circular slide-rule, in that a fixed outer airspeed scale and a rotating mach scale controlled by static pressure are both read against a common airspeed-controlled pointer.

Other new products are a periscope and the Audio approach system. The latter is employed to give a pilot audible indication, by means of a generated sound-pattern, of approach speed during carrier landings; Kelvin Hughes have developed the sensing unit in conjunction with the M.o.S. and the R.A.F. Institute of Aviation Medicine. The periscope fits the normal K. and H. sextant mounting, is fully retractable and can be extended up to 10in. The field of view is 20 deg with a ×2 magnification; the normal freedom of the mounting permits the unit to rotate through 360 deg in azimuth and to be tilted. A distantly related item is a periscopic drift meter, illustrated at lower right, which can be used at all altitudes up to 50,000ft and at ground speeds up to 600 knots.

The Lockheed Hydraulic Brake Co.,

Hymatic PS48 hot-air reducing valve.

Ltd. Following exhaustive testing with all available "non-flam" fluids, the company are satisfied that they can offer hydraulic-system components suitable for operation in safety-fluid systems. The work has involved type-testing a suitable pump and the exploration of lubrication and corrosion during endurance running. All Lockheed hydraulic equipment, including Servodyne powered flying controls, has been subject to ground testing with non-flam fluids; an extensive flight-test programme has also been undertaken.

The "silent" cut-out valve, developed to eliminate hammer from a flow of 12 gal/min, is now in production for such aircraft as the Viscount and Beverley. This component is fitted with a damped change-over valve and an integral relief valve, and is suitable for operation at pressures up to 2,550 lb/sq in. Another Lockheed hydraulic product is a manual/hydraulic actuator for the flaps of the Auster A.O.P.9. The entire unit, which incorporates a self-contained hydraulic system, weighs 4½ lb complete with handle, and it provides an output force of 750 lb for a pilot effort of less than 20 lb. In the A.O.P.9, four full strokes will give an output stroke of 2.1in,

Integral Type 199 hydraulic motor.

sufficient to apply full flap. The valving is such that the flap is locked hydraulically at any selected position but can blow back when aerodynamically overloaded.

In the field of engine-driven hydraulic pumps, the Mk 8 (virtually a doubled-up pair of Mk 7s) is now in production for many of the most important British aircraft. Still larger pumps are being developed. Lockheed undercarriages are being made for several new aircraft, and production units are being delivered for Venoms, Beverleys, helicopters and other types. The Beverley, Comet and D.H.110 incorporate nosewheel steering.

Joseph Lucas (Gas Turbine Equipment), Ltd. New gas turbines, particularly those for which afterburners are being developed, are requiring ever-increasing rates of fuel supply. The Lucas range of fuel pumps (GB.200, GBB, GD and GTD) now covers the range 450 to 2,500 gal/hr at a pressure of 2,000 lb/sq in, and development is proceeding upon a larger unit for considerably greater delivery. Kinetic servo valves are replacing the half-ball type of valve in some pumps, for the former is less sensitive to "dirty" fuel (and hence better suited to wide-cut fuels) and the mechanism is not pressure-conscious and hence gives a better response characteristic.

Use of wide-cut fuels of varying specific gravity has led to the development of two new methods of governing. The first is applied to smaller pumps and is known as the density compensator. Against the centrifugal-pressure component of the governor is applied a bias pressure responsive to the variation in viscosity with change in fuel density. The second governor, known

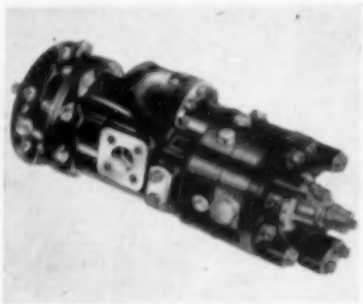
Kelvin Hughes percentage tachometer indicator (generator illustrated, left).

as the hydro-mechanical governor, is fitted to larger engines, and provides a hydraulic reference pressure independent of any variable factors such as fuel density. It operates by balancing fuel pressure against the centrifugal force of a weight rotating on the end of a cantilever, to close a valve admitting pump-delivery pressure through a restricting orifice to the cantilever chamber. This type of governor may be applied in various ways to operate other mechanisms.

A recent centrifugal pump, designed to supply afterburner fuel, has increased running clearances to permit operation with dirty fuel. Driving power is obtained by a single- or two-stage turbine running on compressor-bleed air, speeds of 25,000 to 30,000 r.p.m. being required to achieve the desired fuel pressure. An addition to this pump, now under development, automatically compensates for governor creep by maintaining the datum constant over the entire speed range.

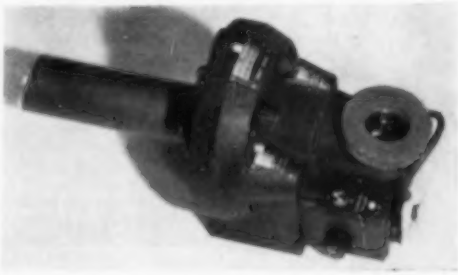
Another recent development is a proportional flow control unit, which makes use of a novel arrangement whereby a small flow in a by-pass circuit is controlled in accordance with P, requirements, the flow in the main supply then being made a true multiple of this flow.

Lucas also have new developments in combustion equipment, including space



Lucas Type GBB fuel pump.

Kelvin Hughes periscopic drift-meter.



FOLLAND GNAT

(BRISTOL ORPHEUS ENGINE)

The Gnat light fighter has all that is best in modern performance and equipment allied to unique manœuvrability. Easy to make, maintain and operate, it springs from an intense concentration over the past four years of a new engineering team led by the man who designed the Canberra.

In a world of increasing complications and many consequent setbacks we at Follands — together with the makers of the engine and many items of equipment — have recognised that there is room for a simple, efficient and versatile fighter of high performance.

We are proud that the value of our idea is increasingly recognised among those who frame air policy in the countries of the free world.

FOLLAND *PIONEERS OF THE LIGHT JET FIGHTER*

FOLLAND AIRCRAFT LIMITED · HAMBLE · SOUTHAMPTON · HANTS

THE ROLLS-ROYCE WAY

to Copenhagen, Oslo, Stockholm

When you fly BEA to the Northern Capitals, they really put down the red carpet for you. From start to finish you travel with every creature comfort you could expect. And not only that. You fly non-stop and fastest in the wonderful Viscount, powered by its four great Rolls-Royce engines. You enjoy admirable food and drink. You have both a steward and stewardess at your beck and call. Flying BEA Viscount, in fact, is not travelling in the ordinary sense of the word. Far from it. So much so that Lord Strathalmond, Chairman of the British Petroleum Company, said " I could not have wished for anything better in terms of both aviation and comfort ". Altogether marvellous service at tourist fares. Ask your Travel Agent.

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BRITISH EUROPEAN AIRWAYS

Accessory Developments...

heaters, and a new mechanical jet-pipe temperature control.

Negretti and Zambra, Ltd. This company have developed the transmitter unit for a fuel flowmeter system, the associated integrating indicator being a Smiths product. The transmitter, illustrated on p. 405, is fitted with a manual resetting for fuel with a specific gravity between 0.74 and 0.82. The unit weighs 8 lb and has standard ranges from 10 to 200 or 250 lb/min.

Normalair, Ltd. Most important of the new products from the Yeovil company is the liquid oxygen converter, which is manufactured under licence from the American Bendix Aviation Corporation. Each converter consists of a double-walled, vacuum-insulated container connected to the aircraft oxygen system by way of an evaporating coil and a number of valves. Gaseous oxygen at 70 lb/sq in is finally passed to the oxygen regulator and thence to the demand breathing mask.

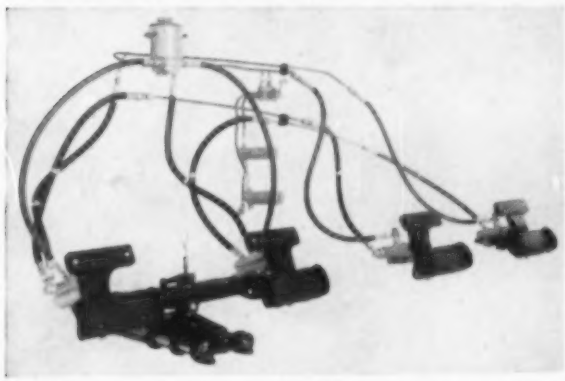
For a typical fighter, the complete system comprises converter, contents gauge, filler valve, build-up and vent valve, Mk 17 demand regulator and Type A.13A mask. An indication of the saving in space and weight made possible by the new system is provided by comparing the bulk (3.6 cu ft) and weight (90 lb charged) of six 750 litre cylinders with the figures for a corresponding liquid converter. Such a unit would be of 5 litres capacity, and would weigh 29.5 lb charged and occupy 0.7 cu ft.

A new extension of Normalair activities is the manufacture, also under American licence, of cold-air units. A typical turbine/fan unit, designed for a nominal airflow of 10 lb/min, weighs 10.8 lb and measures 8½in long by 9½in diameter. Other new products include a very compact and light portable oxygen set for civil use (weighing only 3½ lb fully charged yet providing one hour's endurance) and a smaller and lighter (2.4 lb compared with 3.6 lb) version of the standard 5in ground conditioning connection.

Oldham and Sons, Ltd. This company have one of the world's widest ranges of batteries suitable for all types of aircraft. One of the latest designs is a 12-V, 25 amp-hr unit of entirely new design providing greater mechanical strength, a lighter weight and improved unspillable characteristics. The Type H battery is in wide service and has shown itself capable of starting the largest turbojets over a considerable range of ambient temperatures. This battery can supply discharge currents up to 1,000 amp, and is employed, *inter alia*, on all three types of V-bomber. A civil battery based on the Type H is dimensionally interchangeable with the American AN-3150, although the latter is not required to have so high an electrical performance as the Oldham unit.

Normalair/Bendix liquid oxygen converter.

The Palmer Tyre, Ltd. An entirely new, and novel, development is the resonance compensator for helicopters. It is well known that resonance, or sympathetic vibration, can be a problem at certain critical rotor speeds when the helicopter is resting on the ground with the wheel brakes on. Such resonance can be overcome by making the combined stiffness of the undercarriage leg and tyre assembly equal in all directions, with a natural frequency out of phase with the rotor.



The Palmer Tyre hydraulic braking system for a side-by-side training aircraft (Hunting Percival Jet Provost).

As most legs are cylindrical, and equally stiff all round, the Palmer compensator eliminates resonance by equalizing the directional stiffness of the tyres, which normally vary by as much as five to one from the rolling to the lateral plane. It comprises a pair of spring units connecting the front and rear of the leg to the front and rear brake attachments. When brake is applied and the brake frame is subjected to alternating axial torque it is free to oscillate to the same degree of angular movement and at the same rate as the lateral oscillation. To prevent overloading the units they become "solid" connectors at the end of their travel.

Another new development is a wholly self-contained hydraulic brake system, developed in conjunction with Hunting Percival for the Jet Provost. The system is cheap and light, owing to the fact that the brakes are energized directly by toe pressure.

The master cylinders are interchangeable with the standard brake pedals on the Hunting Percival rudder bar, the latter being popular with pilots on account of their very small brake-pedal movement. Normally the pupil controls braking, but he can be immediately overridden by the instructor, the latter having pedals which isolate the pupil's line and open the instructor's master cylinder. When the parking control is used the brakes are pressurized more heavily than in normal braking, and a temperature compensator is provided to allow for expansion of the oil within limits of ±40 deg C.

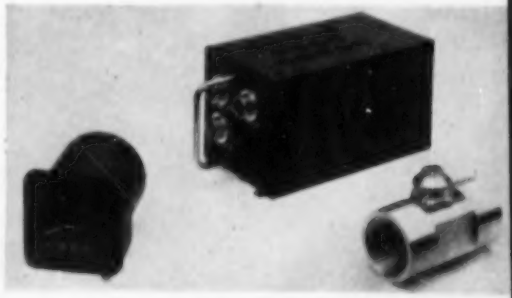
Peto and Radford, Ltd. The new 12-ECM.13-V battery is one of the latest of the "Dagenite" series, and embodies a new feature in that it is ventilated. It has a capacity of 25 amp-hr at 24 V. Another new accumulator is the 12-ECC.13-B, designed to start turbojets and power complete electric systems. Also a 24-V battery, this is an unspillable unit with Porvic envelopes enclosing the negative plates to eliminate the possibility of internal short circuits. Housed in boxes moulded in high-impact polystyrene, the cells are held in a strong light-alloy container coated on the inside with Araldite resin to prevent corrosion.

The Plessey Co., Ltd. Developments in engine-starting equipment are proceeding at a high rate and have recently resulted in a new regenerative monofuel unit and the first British-designed air-turbine starter. The latter (Type PTSA 50/40) replaces liquid-fuel starters where low-pressure air is available and operational requirements call for minimum fly-away weight. The present size of pneumatic starter consumes about 1.4 lb/sec of air from a 40 lb/sq in (gauge) supply, and can accelerate the largest turbojets in service to idling speed in 13 sec from pressing the button. The design is such that air can be accepted over a wide range of temperatures and at any pressure from 18 to 100 lb/sq in. Weight is 15 lb, or as little as 19 lb including ducting and quick-release air connections.

Also designed to start the largest turbojets, the new liquid-fuel (iso-propyl nitrate) starter dispenses with a pumping unit. Starting is effected with the assistance of a small store of high-pressure air for scavenging and the aircraft batteries for h.f. ignition and control.

Other new developments include a ram-air turbine, weighing but 10 lb, which powers the first British emergency hydraulic system for powered controls to be so energized. At 150 kt i.a.s. the TRA 150/2 turbine provides 2 hydraulic h.p.; at higher speeds the output increases, 4 gal/min at 3,000 lb/sq in being delivered at 320 kt i.a.s. The unit is designed for use at conditions equivalent to Mach 1 at sea level, and can, of course, drive any rotating machinery. Plessey have also developed a self-contained hydraulic power pack, electrically driven, for the emergency operation of essential services by an independent oil supply.

Integral/Faure Herman electronic flowmeter.



Accessory Developments...

Further details of the company's very wide range of development will be given in succeeding issues. A new electric actuator, illustrated opposite, is the rationalized Jaguar offset linear unit, with which any Jaguar end-fitting can be used; various combinations of stroke/load can be obtained by direct adjustment.

The Pulsometer Engineering Co., Ltd. Air-turbine fuel pumps of very advanced design are now in production in ratings up to 60 b.h.p. turbine output, the range including units for flight-refuelling flow-rates. The Pulsometer turbine is of the single-rotor type, and a centrifugal governor maintains turbine r.p.m. constant irrespective of all disturbing factors; this governor guards against turbine run-away even in the event of severe negative-g, fuel vaporization or draining of the tanks.

Another wholly new development is a fuel pump based on entirely new principles. Employing a two-stage system, the pump delivers full flow under all conditions of acceleration, and a particular feature of the pump is its exceptional vapour-clearing capacity. The unit is being produced with electric or hydraulic drive, and larger sizes with air-turbine drive are in the early stages of development. A variety of fuel pumps are being developed with hydraulic-motor drive to meet probable future requirements.

Rotax, Ltd. During the past year, Rotax have developed an advanced iso-propyl nitrate starter. The design is such that the unit is simple and compact and current-drain is minimized. During the first second of operation 5 amp is needed, only ½ amp being required thereafter. The air consumption is a maximum of ¼ lb at 200 lb/sq in, and the fuel consumption no more than five or six pints per start. This consumption suffices to accelerate a gas turbine with an inertia of 680 to 700 lb-ft from rest to 2,000 r.p.m. in from five to seven seconds.

For engines with a moment of inertia of only 75 to 80 lb-ft a low-pressure air starter has been produced. Design features include a rotor of light alloy and a compound planetary reduction gear. Peak output is 40 b.h.p. with an airflow of 1½ to 1¾ lb/sec. The time to cut-off speed (2,300 r.p.m.) is 5½ sec with a flow of 0.8 lb/sec and with a pressure drop across the starter of 250 lb/sq in (from a 3,000 lb/sq in supply at 15 deg C). Hot-air

Rotax iso-propyl nitrate turbo-starter.

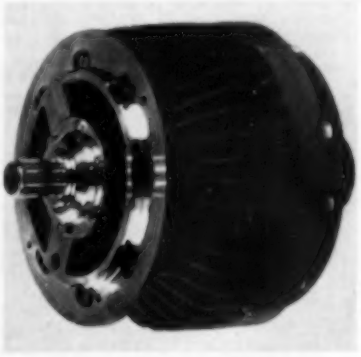
starters are also under development. These units have an operating temperature range from −27 to 200 deg C, the air being introduced at any temperature between +60 and 330 deg C.

One of the latest Rotax generators is an air-cooled unit with a very wide speed range. Designed for use in 28 V regulated D.C. systems, the rating is 6 kW between 2,860 and 10,000 r.p.m. Within this speed range the voltage is maintained at 28 ± 0.5 at any load up to 200 amp. Interpole and pole-face windings ensure spark-free commutation, and efficient cooling is maintained by a system of ducting together with a hollow armature shaft.

Another recent development is a circuit breaker with very high rupturing capacity. It is a single-pole unit having two breaks in series, and is designed for 28 or 112 V D.C. systems. There are fixed and movable contacts, arc-quenching devices and two pairs of auxiliary contacts. Manual control can be effected from push buttons, and the unit can be made to operate automatically under the control of a sensitive tripping unit designed to open the contacts when a predetermined current flows in one direction only. The breaker can be locked in the closed position to overcome a reverse current of about 800 amp which may be encountered in aircraft using starter/generators. Alternatively the unit may be employed for normal overload protection operating on currents in either direction, in which case it is possible to provide inverse time lag. In a 112 V system, the rating is 300 amp continuous with a maximum rupturing capacity of 10,000 amp at 60,000ft. The weight is 5½ lb.

New actuators include the compact A.1603, designed to operate at a load of 4,500 lb in the control of tail incidence at all heights up to 60,000ft. The unit has dual motors and a stroke of 2.56in, current consumption at 18 to 29 V D.C. being 20 amp (8 amp auxiliary motor) and maximum stroke time 20 sec (88 sec with auxiliary motor). Another new unit is the ZA.3801 ram assembly, designed for the operation of air brakes. Fitted with a high-efficiency recirculating-ball thread, the 3801 has a design working load of 14,000 lb and a maximum extension of 10in for a total weight of 15 lb. Rotax have developed a wide range of such units, which can be driven by any high-speed prime mover such as an air turbine.

Rotol, Ltd. The largest airscrew at present developed by the company is a 16ft four-blader suitable for the Proteus 755—and, hence, for the Britannia. A prototype of this airscrew has completed hangar trials, and it follows standard Rotol practice in having a fixed cylinder and moving piston, together with a two-line hydraulic circuit to give constant-speeding,

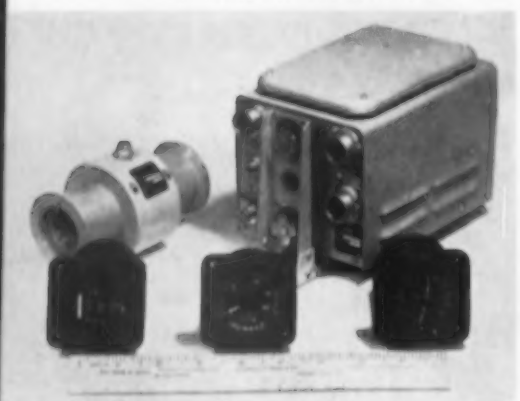


Rotax low-pressure-air starter.

feathering and reversing. The blades are solid light-alloy forgings and the chord is 14½in. These blades make use of the company's very successful rebated-blade de-icing, the heating elements extending to 21 per cent chord over the inner 68 per cent of each blade.

One of the latest accessory-drive boxes to be cleared for publication is a military box mounted between a pair of Rolls-Royce Avon turbojets. Drive is taken from whichever engine happens to be turning the faster, by means of a free-wheel system. This gearbox is, like other Rotol boxes, self-contained, with its own lubrication system.

Simmonds electronic flowmeter.



Teddington Type FMA electro-pneumatic gate valve.

Salford Electrical Instruments, Ltd. The improved frequency-modulated radio altimeter Mk 5 has now been placed in production. The latest development is a variable-frequency audio-oscillator, and other new products include additions to the range of precision potentiometers and an S.E.I. electro-magnetic transducer system.

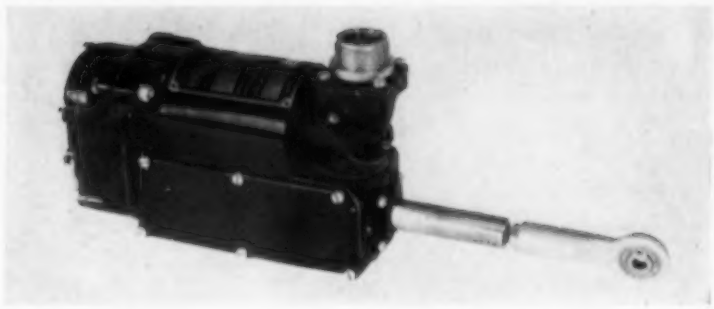
Saunders Valve Co., Ltd. Several completely new fluid-control developments have taken place during the past year in order to meet the requirements of handling various liquids and gases at elevated temperatures or high pressures. An example of the former requirement is a large-bore spherical plug cock capable of handling air at 250 deg C; high-pressure cocks include one for fuel at 2,000 lb/sq in and another for tank pressurization (which is an axiflow unit passing nitrogen at up to 4,000 lb/sq in). Two new forms of applying electrical actuation to spherical plug cocks have been developed, both of which are singularly light and compact.

Smiths integrating flowmeter indicator.

Self-Priming Pump and Engineering Co., Ltd. Undoubtedly the major advance by S.P.E. has been the development of an immersed tank booster pump driven by a turbine running on compressor-bleed air. Such a pump has been found to be considerably lighter, and rather more compact, than equivalent units driven electrically. Such pumps become increasingly attractive as the required output is increased.

The first of S.P.E.'s turbine-driven pumps has a rating of no less than 3,500 gal/hr at 11 lb/sq in, and even this by no means represents the limit to what can be achieved with such a drive. A two-stage centrifugal impeller is used, driven through bevel gearing by a two-stage impulse turbine which is supplied with air taken from a suitable stage (usually the first or second) of the engine compressor. The whole unit is fully governed both to prevent overspeeding and to minimize air consumption. Extensive testing has been carried out, including simulated operation at 60,000ft with high rates of climb and descent, and the unit is now fully approved.

Short Brothers and Harland, Ltd. In addition to designing and building aircraft, Shorts have developed a highly engineered analogue computer, an aircraft-handling simulator incorporating the company's computors, guided-weapon systems, a range of hydraulic components and high-frequency electric motors. The latter can be run off supplies in the 400 to 3,000 cyc/sec range at shaft speeds very much lower than those of two-pole synchronous machines. It is possible, for example, to obtain as low a speed as 1,200 r.p.m. on a 400-cycle supply.



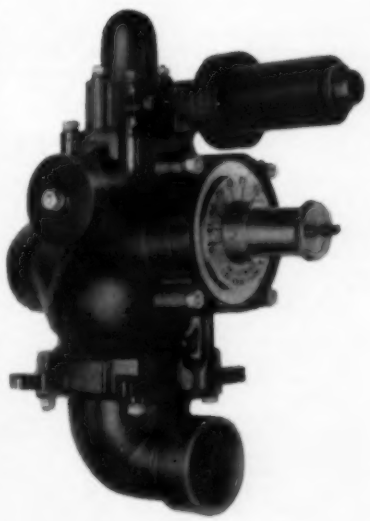
Plessey rationalized Jaguar actuator.

Most of the Short motors have been made simple and cheap, for expendable applications. Moulded magnetic parts—instead of using laminations—are standard, and this has led to the development of an important business in magnetic ferrite components.

Short's research department have also produced an electro-hydraulic transducer as a cheap alternative to having an electro-magnetic relay coupled to a spool-type slide valve. The unit has two stages and is assembled as a self-contained unit only 2½ by 2½ by 1½in.

Simmonds Aerocessories, Ltd. The Type 1 flowmeter is an entirely new development, giving a mass reading. An electric signal is transmitted by a sensing head comprising a small stainless steel turbine in a pipe-like housing. The flow of fuel spins the rotor which then induces a signal in a circumferential pick-up coil. The signal is passed to a remote electronic transmitter unit from which two signals are derived, one in the form of a direct current proportional to fuel flow rate and the other a series of uni-directional pulses which are a measure of the total quantity of fuel passed through the sensing unit in a given time. The two output signals finally proceed to a flow-rate indicator and totalizing indicator in the form of a digital computor.

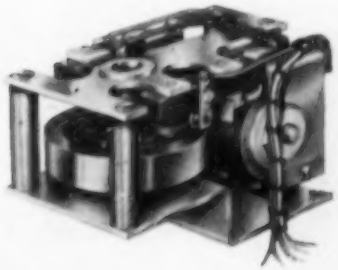
Where mass reading is required with varying types of fuel a specific gravity corrector can be incorporated. If necessary, the latter can be a completely automatic density corrector. The units illustrated opposite comprise the sensing unit (14 oz), transmitter box (3 lb 2 oz), counter (10 oz), flow rate indicator (7 oz) and manual s.g. corrector (10 oz). The sensing head can be incorporated in high- or low-pressure lines, and the pressure drop is normally well below 1 lb/sq in; it does not exceed 2½ lb/sq in even with the rotor jammed at maximum flow conditions.



Negretti and Zambra transmitting unit used in conjunction with Smiths flowmeter illustrated in column one above.

Smiths Aircraft Instruments, Ltd. The company are now able to release details of their entirely new flight system. This condenses the functions of no fewer than 16 instruments into eight standard panel instruments. Particular care has been taken to provide immediate and effective warning of any malfunction, and settings and switching have been reduced to a minimum. Full details of the system were given in the August 19th issue of this journal; from these it will be recalled that the system provides the following: indication of aircraft attitude; indication of magnetic heading from two independent gyro-magnetic compass systems; repeated magnetic heading from other equipment (such as R.M.I.); improved presentation of I.L.S. and V.O.R. displacement information related to heading to give a complete plan picture; flight director control by attitude demand signals; when linked to the Smiths S.E.P.2 autopilot system, full facilities without pilot aid; course-selection common to autopilot and flight director on primary compass indicators; common function selection for radio coupling on autopilot and flight director, including selection of port or starboard

Plessey navigation-light flasher unit.



Accessory Developments...

compass system for heading control; stand-by magnetic compass.

Very advanced techniques are apparent throughout the system, and some of the main components are wholly new. It is undoubtedly the most advanced example of systems engineering yet available for civil use.

Sperry Gyroscope Co., Ltd. The latest type of electrically driven gyro horizon is the H.L.6. This unit, which in military form is styled Mark 3C, provides all the features of the well-known H.L.5 together with the addition of a fast-erection system, power-failure warning and a roll cut-out in the erection system to reduce turn errors. The H.L.6 has already received A.R.B. approval for 1,800 hr inter-overhaul life. Developments are also continuing in several other types of flight instrument.

An ever-increasing range of instrument synchros and electronic components is now being developed for both manned aircraft and guided weapon systems. In particular, a range of instrument synchros has been developed in collaboration with the R.A.E. and these are now available for many applications. For servo-mechanisms, a number of small tacho-motors, both a.c. and d.c., have been developed, and other products include mass-balanced relays and h.f. motors.

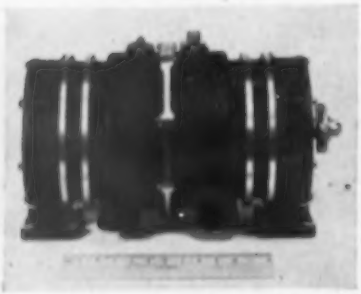
Another new departure for Sperry is the development of an integrated power-control system to co-ordinate the three modes of manual control, automatic control and autostabilization. The aim is to reduce the multiplicity of components and the complexity consequent upon the use of three separate systems. This development is well advanced and is associated with one new aircraft project. It is, however, of a flexible nature, and capable of application to varied requirements.

Sperry have also taken up the licence-manufacture of the hydraulic pumps and motors of Vickers, Inc. of Detroit. Some of the equipment is already in production in Britain, and all is of a proven nature. The equipment ranges from 4 h.p. fixed-displacement motor units to variable-delivery pumps with a capacity as high as 20 gal/min.

Teddington Aircraft Controls, Ltd. A new temperature control valve (Type FOW/A/1) has been developed for use in a guided-weapon heating system, and is designed to shut off the airflow should the air-temperature exceed a predetermined value. The valve element is a plate soldered to a bellows, which can be seated on a ring seal according to the deflection of a bi-metallic sensing rod.

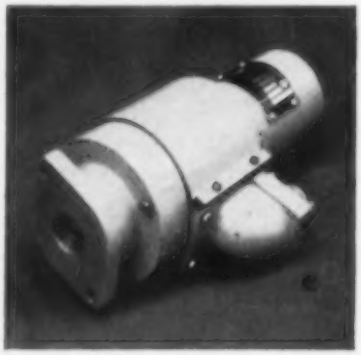
Another new product (picture p. 404) is the

Wellworthy-Ricardo supercharger.



Type FMA electro-pneumatic gate valve, intended for compressor-bleed systems in which electric actuation may be considered undesirable. The gate is operated by a pair of pistons, of unequal diameter, which are connected with the through-put air upstream of the gate. A solenoid valve which bleeds the larger cylinder allows the force on the smaller piston to overcome that of the larger and so cause the gate to move. The FMA will operate on a minimum pressure of 5 lb/sq in and under ambient temperatures between −55 and 200 deg C; it can handle air at 350 deg C and weighs approximately 5 lb 4 oz.

Type FKT is an afterburner control unit. It is arranged to sense pressures at a stage on the engine compressor and at the reheat burner and, at a predetermined ratio of these pressures, to operate an integral throttle which controls the flow of air to the turbine driving the afterburner fuel pump. Teddington have also developed a variety of wholly pneumatic controllers, which can be used for governing cabin-air temperature or pressure. Some units embody several valves in one housing, and the more complex types incor-



Western Manufacturing EROJ actuator.

porate sequencing of these valves. Another development is the miniaturization of the amplifiers used in some cabin temperature control circuits, the original thermionic valves being replaced by magnetic equipment. Development continues upon a wide range of other valves, switches and control equipment.

Triplex Safety Glass Co., Ltd. Windscreens heated by an electrically conducting layer of gold, roughly 0.0000002in thick, are now in full production for various types of aircraft, including night-fighter Meteors. Up to 1,000 watts per square foot can be accommodated and gold-film glass is now available in sizes up to 38in by 24in.

Bullet-proof, bird-proof and pressure-resisting windscreens are in production by Triplex for such aircraft as the Viscount, Hunter, Victor and Valiant.

Vickers - Armstrongs, Ltd. Accessory developments include a variety of improved furnishing equipment, including seating and chemical closets, together with several advanced cocks and valves. Of the latter the A5494 valve and A5339 cock are typical. The former is a non-return valve for handling air at up to 350 deg C, and is made in heat-resistant stainless steel. The valve plate, which is spring-loaded against a knife edge, can withstand pressures up to 120 lb/sq in. The A5339 cock is a recent type of fuel cock, operated by a Western Manufacturing electric actuator of smaller size than usual. In 1in B.S.P. size it weighs only 3.03 lb and is notably compact.

Venner SZ/6/12 missile accumulator.

Venner, Ltd. The illustration shows the SZ/6/12 lightweight silver-zinc accumulator made up into the form of a power pack for driving the heaters and rotary transformers of guided missiles. Many other, and larger, types of silver-zinc accumulators are in production, including the H40/24 used in the Gnat, where it supplies both the general electric system and the powered controls. An unusual development is a self-contained emergency lighting unit now in use on all T.C.A. Viscounts. Intended for roof or wall mounting (but also capable of being used as a portable lamp), the set incorporates a Venner accumulator giving one hour's illumination automatically should the mounting suffer a predetermined acceleration in any direction in the horizontal plane.

Several new patterns of time-delay switch, crash switch, and code sender have also been developed.

Wellworthy, Ltd. Although widely used in other spheres, the Wellworthy-Ricardo supercharger is still experimental in relation to the aircraft industry. Illustrated on this page, it is a fixed-displacement unit, with two banks of seven double-acting pistons actuated by a single, non-rotating wobble plate. The pistons, which are reciprocated by rods centralized in long guides, do not contact the cylinder walls but have a small clearance and are sealed by labyrinth grooves. Both cylinders and pistons are of light alloy, without liners.

Western Manufacturing (Reading), Ltd. A range of standard electric actuators is steadily being expanded, with differing thrusts, speeds, strokes, attachments and plug outlet positions. The final standard range will be made up of units which can be so assembled as to give virtually any performance required. It is expected that this procedure will not only simplify storekeeping but will also reduce purchase price. So far the range is restricted to linear actuators with not more than 1,000 lb thrust; other units are being added, together with a range of rotary actuators. One of the latter is illustrated.

Westinghouse Brake and Signal Co., Ltd. Pioneers of metal rectification, this company have recently developed a new form of rectifier construction which makes possible a much more compact unit for any given rating. The new units are contact-cooled, losses being dissipated by direct conduction instead of by the normal convection method.

Other new developments include high-voltage tubular rectifiers in various types of construction, and, for D.C. power supplies, an aluminium-based rectifier has been developed with much lower weight/power and volume/power ratios than have the Westalite series of rectifiers at present in use.

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The specifications were met by Avro Aircraft Limited of Malton, Canada. The interceptor is the Avro CF-100.
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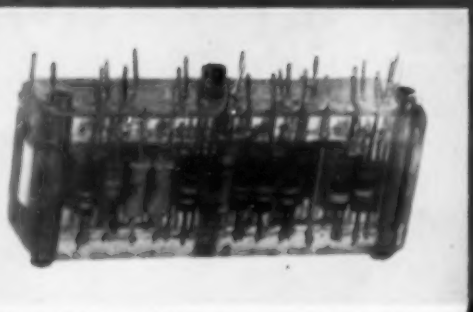
In the construction of airframes, BAKELITE Laminated Material is extensively used for tooling. One-sixth the weight of mild steel, strong, it is excellent for press tools, jigs, patternmakers' layouts.



BAKELITE Polyester and Epoxy Resins are extensively used for "potting" electrical circuits. Other BAKELITE Resins have particularly useful functions as adhesives for bonding wood, metal, plastics, glass and glass-fibre.

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Many small components are made from VYBAK Moulding and Extrusion Compounds and BAKELITE Moulding Materials. Cable covering, switch covers, instrument panels, cases and innumerable small and important parts.

Components of BAKELITE Laminated are widely used in modern aircraft. Most of them small in size, yet vital parts of the aircraft. Fairleads, pulleys, cleats, guide-plates are some of the applications, as well as aircraft flooring.

BAKELITE Polyester Resins are used with glass-fibre to produce low pressure mouldings of high strength/weight ratio and high impact strength, thus making them suitable for a variety of aircraft components. Similar combinations are widely used for jigs and tools.

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[illegible] this material of the future, a line of development as brilliant and progressive as its own. These and many other applications can be seen on the Bakelite Stand No. 50

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Vickers Viscount in Polystyrene. Model and stand are hollowed to save material. Three moulds only were used, calling for highly complex tooling.

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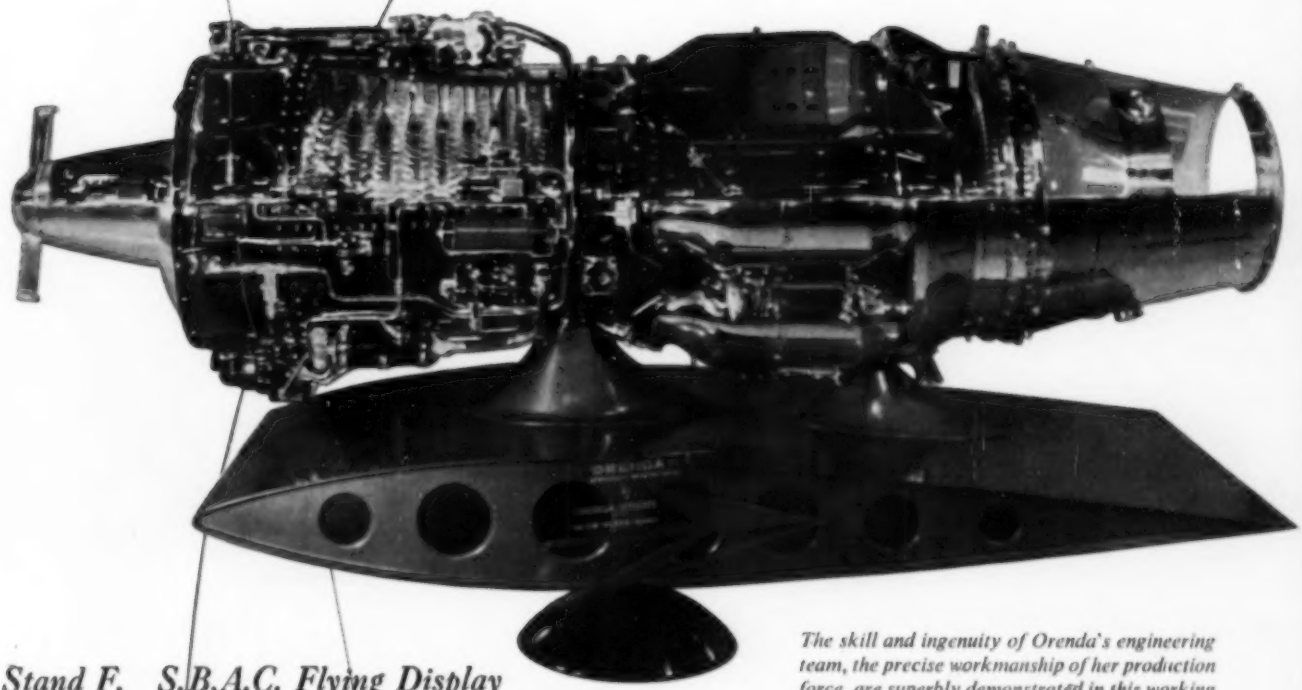
ORENDA

power going places



Stand F. S.B.A.C. Flying Display
Farnborough, Sept. 5-11, 1955

The skill and ingenuity of Orenda's engineering team, the precise workmanship of her production force, are superbly demonstrated in this working cutaway showpiece Orenda 11 on display at the S.B.A.C. Flying Display and Exhibition.

Main entrance to the plant where more than 2500 Orendas have been built in little over two and one half years.

In England, in Europe, in Canada, Orenda-powered Sabres and CF-100's of the Royal Canadian Air Force daily demonstrate leadership in their respective fields. Now Orenda Sabre 6's have been chosen for the South African Air Force "after giving consideration to all the best jet fighters now in production"—another tribute to Orenda power.

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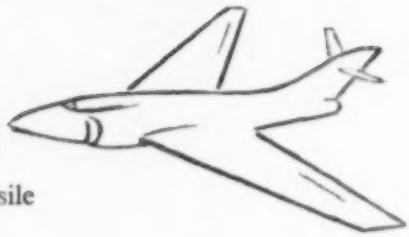
A.V. ROE CANADA LIMITED—MEMBER, HAWKER SIDDELEY GROUP



WROUGHT TITANIUM and titanium alloys are being increasingly used in the aircraft industry where their high strength/weight ratio at moderately elevated temperatures can lead to considerable savings in weight over the use of more conventional materials.

Titanium is about half the weight of steel, with a corrosion resistance often superior to stainless steel. By alloying, its tensile strength can be raised to about 70 tons/sq. in.

Manufacture in this country has been pioneered by I.C.I. Metals Division, and the metal is now available in all the usual forms, such as billet, bar, plate, sheet, wire or tube.

TITANIUM & ALUMINIUM

The high strength/weight ratio of aluminium alloys, combined with excellent durability, provides the aeronautical engineer with construction materials of established reliability.

'Kynal' wrought aluminium alloys, produced to most foreign and British aircraft specifications, are available in a variety of forms including extruded sections and clad and unclad sheet.

They are made by I.C.I. Metals Division, whose rigid technical control during production ensures that they will stand up to the most rigorous conditions.

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BRITISH INDEPENDENT AIR OPERATORS USE

CELLON *PROTECTIVE AIRCRAFT FINISHES*

CELLON LIMITED, KINGSTON-ON-THAMES, ENGLAND TELEPHONE: KINGSTON 1234 (9 LINES) TELEGRAMS: "AJAWB, 'PHONE, KINGSTON-ON-THAMES"
ALSO MANUFACTURED IN AUSTRALIA, CANADA, FRANCE, HOLLAND & NORWAY

for

structural

strength

at

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speed

Hiduminium

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HIGH DUTY ALLOYS

BRITISH POWER UNITS 1955

Maker and Type	Classification	Swept vol. (litres) or mass flow (lb/sec)	Max. boost (lb/sq in) or press. ratio	Max. rated power				Typical cruising s.f.c.	Power/ weight ratio (per lb)	Power/ frontal area (per sq ft)	Remarks
				s.h.p.	lb thrust	r.p.m.	s.f.c.				
Alvis:											
Leonides 502/5 ...	P, 9r, air	11.78 lit	8 lb/sq in	570	n.a.	3,000	—	0.50	0.73	59.5	Typical fixed-wing Leonides.
Leonides 524/1 ...	P, 9r, air	11.78 lit	7 lb/sq in	565	n.a.	3,200	—	0.49	0.892	—	Vertical helicopter engine.
Leonides Major 1-1	P, 14r2, air	18.28 lit	8 lb/sq in	870	n.a.	3,000	0.72	0.48	0.756	106	Fixed-wing Major.
Leonides Major 1-2	P, 14r2, air	18.28 lit	8 lb/sq in	870	n.a.	3,000	0.72	0.48	0.87	—	Any-angle helicopter engine.
Armstrong Siddeley:											
Double Mamba ASMD.3	T, 2 (10a, 6cc, 2t)	37 lb/sec	5.35:1	2,740	770	15,000	0.71	—	1.383	262	Two independent power sections.
Mamba ASM.5 ...	T, 10a, 6cc, 2t	18.5 lb/sec	5.35:1	1,480	300	15,000	0.71	—	1.94	347	Constant-speed engine.
Python ASP.3 ...	T, 14a, 11cc, 2t	52.5 lb/sec	5.35:1	3,670	1,180	8,000	0.81	—	1.20	260	
Sapphire ASSa.4	J, a, ann, t	n.r.	n.r.	n.a.	9,700	n.r.	n.r.	n.r.	n.r.	n.r.	
Sapphire ASSa.6	J, 13a, ann, 2t	n.r.	n.r.	n.a.	8,000	8,600	0.90	0.85	2.97	1,120	Large-scale service.
Sapphire ASSa.7	J, a, ann, t	n.r.	n.r.	n.a.	10,500	8,600	0.885	n.r.	3.41	1,540	Production at this rating.
Screamer	R, oxidant + Avtur	n.r.	n.r.	n.a.	n.r.	n.a.	n.r.	n.r.	n.r.	n.r.	
Viper ASV.3 ...	J, 7a, ann, 1t	30 lb/sec	3.5:1	n.a.	1,640	13,400	1.09	—	4.32	400	Short-life engine.
Viper ASV.5 (101)	J, 7a, ann, 1t	30 lb/sec	3.5:1	n.a.	1,640	13,400	1.09	—	3.142	400	Long-life engine.
Viper ASV.7R ...	J, 7a, ann, 1t, a/b	30 lb/sec	3.5:1	n.a.	2,470	13,400	—	—	n.r.	610	Long-life engine with afterburner.
Viper ASV.10 ...	J, 7a, ann, 1t	n.r.	n.r.	—	2,000	n.r.	n.r.	—	3.51	365	Design figures for new engine
Blackburn:											
Bombardier 702 ...	P, 4l, inv., air	6.524 lit	n.a.	173-220	n.a.	2,600	—	0.45	0.5-0.6	50-55	Direct-injection engine.
Artouste 600 ...	T, 1c, ann, 2t	7.2 lb/sec	4.12:1	475	—	34,000	0.99	—	1.72	190	Single-shaft engine.
Palas 600	J, 1c, ann, 1t	7.2 lb/sec	4.12:1	n.a.	350	34,000	1.1	—	2.1	250	
Palouste 500 ...	GP, 1c, ann, 1t	4.7 lb/sec	4.19:1	258 g.h.p.	2.725 lb air/sec at 57.25 lb/sq in or 310 lb fuel per hour at 35,000 r.p.m.						Air-producer for helicopters
Turmo 600 ...	T, 1c, ann, t+t	7.2 lb/sec	4.12:1	450	—	34,000	1.04	—	1.61	180	Free-turbine drive at rear.
Coupled Turmo ...	T, 2 (1c, ann, t+t)	14.4 lb/sec	4.12:1	900	—	34,000	1.04	—	—	—	Any-angle helicopter engine.
Bristol:											
B.E.25	T, a+a, cann, t+3t	86 lb/sec	n.r.	4,000	2,730	10,500*	n.r.	0.38	1.89	660	Constant power to 20,000ft.
Centaurus 173 ...	P, 18r2, air	53.6 lit	—	2,935	n.a.	2,800	—	0.42	0.85	180	Sleeve valves.
Hercules 758 ...	P, 14r2, air	38.7 lit	13 lb/sq in	2,090	n.a.	2,800	—	0.42	1.00	142	Sleeve valves.
Olympus 101 ...	J, a+a, cann, t+t	n.r.	n.r.	n.a.	11,000	6,500*	0.79	0.75	3.1	1,290	Production engine.
Orpheus BOr.1 ...	J, a, cann, t	n.r.	n.r.	n.a.	3,285	n.r.	n.r.	n.r.	4.4	n.r.	Higher ratings in prospect.
Proteus 755 ...	T, 12a+1c, 8cc 2t+2t	47 lb/sec	7.2:1	3,650	1,220	12,000	0.60	0.48	1.375	470	Free-turbine engine. r.p.m. is for compressor.
de Havilland:											
Gipsy Major 10/2	P, 4l, inv. air	6.1 lit	n.a.	145	n.a.	2,550	—	—	0.455	—	Inlet-port injection.
Gipsy Major 200	P, 4l, inv. air	6.79 lit	n.a.	200	n.a.	2,600	—	0.51	0.50	—	Unblown, direct drive.
Gipsy Queen 30/2	P, 6l, inv. air	10.2 lit	n.a.	250	n.a.	2,500	—	0.51	0.476	55.5	Blown, geared, injection carb.
Gipsy Queen 70/2	P, 6l, inv. air	10.2 lit	7.5 lb/sq in	380	n.a.	3,000	—	0.46	0.526	84.4	
Ghost 103 ...	J, 1c, 10cc, 1t	88 lb/sec	4.6:1	n.a.	4,850	10,250	1.09	—	2.24	317	
Goblin 35 ...	J, 1c, 16cc, 1t	63 lb/sec	3.67:1	n.a.	3,500	10,750	1.14	—	2.15	257.5	
Gyron DGy.1 ...	J,	n.r.	n.r.	n.a.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	
Spectre	R,	n.a.	n.a.	n.a.	n.r.	n.a.	n.r.	n.r.	n.r.	n.r.	DSpe. 1 to 5 have run.
Super Sprite ...	R, H_2O_2 + Avtur	n.a.	n.a.	n.a.	4,000	n.a.	—	n.a.	—	—	Jettisonable a.t.o. motor.
Napier:											
Eland NEI.1 ...	T, 10a, 6cc, 3t	31 lb/sec	7:1	2,690	825	12,500	0.624	0.493	1.91	431	
Eland NEI.2 ...	T, 10a, 6cc, 3t	n.r.	n.r.	2,910	885	12,500	0.618	0.482	2.06	466	
Eland NEI.3 ...	T/GP, 10a, 6cc, 3t + aux comp.	31 lb/sec	7:1	2,805	520	12,500	0.624	0.493	1.28	431	For Rotodyne.
Eland NEI.5 ...	T,	35 lb/sec	n.r.	3,765	1,125	12,500	0.56	0.441	2.33	605	Air-cooled turbine blades.
Gazelle NG.1 ...	T, a, cc, t+t	n.r.	n.r.	1,260	—	—	—	—	—	—	Free-turbine, any-angle engine.
Oryx NOr.1 ...	GP, 12a, 5cc, 2t, + aux comp.	9.9 lb/sec	6:1	750 gas h.p. at r.p.m.		21,900	0.68	—	1.52	—	For Hunting Percival P.74.
Oryx NOr.4 ...	GP,	n.r.	n.r.	925 gas h.p. at r.p.m.		22,400	0.656	n.r.	1.67	—	For Hunting Percival P.105.
Oryx NOr.10 ...	GP,	n.r.	n.r.	,250 gas h.p.			n.r.	n.r.	n.r.	n.r.	
Rolls-Royce:											
Avon RA.7 ...	J, 12a, 8cc, 2t	n.r.	n.r.	n.a.	7,500	7,800	0.92	—	3.05	771	In service.
Avon RA.7R ...	J, 12a, 8cc, 2t, a/b	n.r.	n.r.	n.a.	9,500	7,800	1.90	—	3.2	977	Afterburner. In service.
Avon RA.14 ...	J, a, ann, t	n.r.	n.r.	n.a.	9,500	7,850	0.84	n.r.	3.32	1,009	Redesigned Avon. In service.
Avon RA.21 ...	J, 12a, 8cc, 2t	n.r.	n.r.	n.a.	8,000	7,900	0.925	—	3.17	822	In service.
Avon RA.25 ...	J, 12a, 8cc, 2t	n.r.	n.r.	n.a.	7,000	7,800	0.91	—	2.87	721	Civil engine.
Avon RA.26 ...	J, ann, t	n.r.	n.r.	n.a.	10,000	n.r.	0.86	n.r.	3.58	1,063	
Avon RA.28 ...	J, ann, t	n.r.	n.r.	n.a.	10,000	n.r.	0.86	n.r.	3.46	1,063	
Conway	BP, a+a, t+t	n.r.	n.r.	n.a.	13,000	n.r.	n.r.	n.r.	n.r.	n.r.	First type-test rating.
Dart 505 ...	T, 2c, 7cc, 2t	20 lb/sec	5.5:1	1,400	365	14,500	0.753	—	1.49	195	
Dart 506	T, 2c, 7cc, 2t	20 lb/sec	5.5:1	1,400	365	14,500	0.727	—	1.47	195	
Dart 510	T, 2c, 7cc, 2t	20 lb/sec	5.5:1	1,600	370	14,500	0.689	—	1.57	220	Also later versions.
Derwent 8 ...	J, 1c, 9cc, 1t	63 lb/sec	4:1	n.a.	3,600	14,700	1.05	—	2.8	360	Over 3½m hours in Meteor.
Griffon 57	P, 12v, liquid	36.7 lit	25 lb/sq in	2,455	—	2,750	—	0.42	1.175	311	Injection carburettor.
Merlin 724 ...	P, 12v, liquid	27 lit	20.5 lb/sq in	1,760	—	3,000	—	0.45	0.99	220	Engine-change unit for Argonaut. Two-stage supercharger
Nene 10 ...	J, 1c, 9cc, 1t	88 lb/sec	4:1	n.a.	5,100	12,500	1.06	—	3.15	378	Built in G.B. and Canada.
R.B.109	T, a+a, ann, t+t	41 lb sec	n.r.	4,020	1,000	n.r.	n.r.	—	2.4-2.5	785	Two-spool engine.
Soar RSr.2 ...	J, a, ann, t	n.r.	n.r.	n.a.	1,810	n.r.	1.27	—	6.56	1,326	Also 1,860 lb rating.

Notes: in col 2, P—piston engine, T—turbocrop, J—turbojet, BP—by-pass turbojet, GP—gas producer for rotor tip-jets, R—rocket, c—centrifugal compressor, a—axial compressor, a/b—afterburner, cc—combustion chambers, t—turbine stages, ann or cann—annular or cannular combustor, r—radial, l—in-line, v—vee-engine, inv.—inverted, Avtur—aviation turbine fuel, H_2O_2—conc. hydrogen peroxide. All determinations of s.f.c. (specific fuel consumption), power/wt ratio and power-frontal area are based upon lb thrust, b h p or total equivalent s.h.p., according to the type of engine considered. *Indicates r.p.m. of low-pressure section. Throughout: n.a.—not applicable; n.r.—not released.

BRITISH MILITARY AIRCRAFT 1955

(INCLUDING RESEARCH TYPES)

Maker and Type	Main Duties	Span ft	Span in	Length ft	Length in	Power Unit(s) No.	Power Unit(s) Type	Power (see note 1)	Normal a.u.w. lb	Wing Loading lb/sq ft	Armament (see note 2) Guns No. Cal. mm	Bombs No. Wt. lb	R.P.s No. Wt. lb	Max. speed m.p.h.	Max. speed ft	Climb to ft	Climb min	Typical Range miles
Armstrong Whitworth:																		
Meteor N.F.14	F.	43	0	49	11	2	Derwent	7,000	20,000	n.r.	4 20	nil	nil	590	n.r.	n.r.	n.r.	n.r.
Sea Hawk F.G.A.4	F.B.	39	0	40	0	1	Nene	n.r.	n.r.	n.r.	4 20	n.r.	n.r.	630	n.r.	n.r.	n.r.	n.r.
Auster:																		
Auster A.O.P.9	O.C.	36	5	23	8½	1	Bombardier 203	180	2,125	10.4	nil	nil	nil	127	—	i.r.c.—	920 ft/min	240
Avro:																		
Vulcan B.1	B.	99	0	97	1	4	Olympus	n.r.	n.r.	n.r.	nil	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Shackleton M.R.2	R.A.-S.	120	0	87	4	4	Griffon	n.r.	86,000	n.r.	4 20	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Shackleton M.R.3	R.A.-S.	126	6½	87	4	4	Griffon	n.r.	n.r.	n.r.	2 20	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
707C	T.	34	2	42	9	1	Derwent	3,500	n.r.	n.r.	nil	nil	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Blackburn and General Aircraft:																		
Beverley C.1	Tt.	162	0	99	2	4	Centaurus 173	11,400	135,000	46.3	nil	nil	nil	238	5,700	10,000	14.7	1,600
Boulton Paul:																		
Balliol T.2	T.	39	4	35	1½	1	Merlin 35	1,280	8,410	33.64	1 7.7	8 25	4 60	288	9,000	10,000	6	670
Sea Balliol T.21	T.	39	4	35	1½	1	Merlin 35	1,280	8,704	34.81	1 7.7	8 25	4 60	285	9,000	10,000	6	655
P.111A	R'ch.	33	6	26	1	1	Nene	n.r.	n.r.	n.r.	nil	nil	nil	n.r.	n.r.	n.r.	n.r.	n.r.
de Havilland:																		
D.H.110	F.	51	0	53	0	2	Avon	n.r.	n.r.	n.r.	4 30	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Venom F.B.4	F.B.	41	9	33	0	1	Ghost	n.r.	n.r.	n.r.	4 20	2 1,000	8 60	n.r.	n.r.	n.r.	n.r.	n.r.
Venom N.F.3	F.	41	9	35	3	1	Ghost	n.r.	n.r.	n.r.	4 20	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Sea Venom N.F.21	F.	41	9	35	3	1	Ghost	n.r.	n.r.	n.r.	4 20	n.r.	8 60	n.r.	n.r.	n.r.	n.r.	n.r.
Vampire Trainer	T.	38	0	34	6	1	Goblin 35	3,500	11,680	44.7	4 20	opc.	8 25	538	s.l.	30,000	14	789
Chipmunk T.20	T.	34	4	25	5	1	Gipsy Major 8	145	2,014	11.57	nil	nil	nil	138	s.l.	5,000	7	280
English Electric:																		
Canberra P.R.3, T.4, B.2, B.5 and B.6	B.R.T.	64	0	65	6	2	Avon	n.r.	n.r.	n.r.	nil	n.r.	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Canberra P.R.7	R.	64	0	66	8	2	Avon	n.r.	n.r.	n.r.	nil	n.r.	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Canberra B.8	B.I.	64	0	—		2	Avon	n.r.	n.r.	n.r.	4 20	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Canberra P.R.9	R.	68	0	65	6	2	Avon	n.r.	n.r.	n.r.	nil	n.r.	nil	n.r.	n.r.	n.r.	n.r.	n.r.
P.1	F.	n.r.		n.r.		2	Sapphire	n.r.	n.r.	n.r.	n.r.	nil	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Fairey:																		
Firefly A.S.7 and T.7	A.-S.T.	44	6	38	3	1	Griffon	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Firefly Mk. 8	Tar.	43	6	38	3	1	Griffon	n.r.	n.r.	n.r.	nil	nil	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Gannet A.S.1 and T.2	A.-S.T.	54	4	43	0	1	Double Mamba	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
F.D.1	R'ch.	19	6½	26	3	1	Derwent	n.r.	n.r.	n.r.	nil	nil	nil	n.r.	n.r.	n.r.	n.r.	n.r.
F.D.2	R'ch.	27	0	52	0	1	Avon	n.r.	n.r.	n.r.	nil	nil	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Folland:																		
Midge	F.(R'ch)	20	8	28	9	1	Viper 101	1,640	4,500 app.	n.r.	2 30	n.r.	n.r.	over 600	n.r.	n.r.	n.r.	n.r.
Gnat	F.B.	22	2	29	0	1	Orpheus	n.r.	n.r.	n.r.	2 30	2 1,000	8 R.P.s	n.r.	n.r.	n.r.	n.r.	n.r.
Gloster:																		
Javelin FAW.1	F.	52	0	57	0	2	Sapphire	n.r.	n.r.	n.r.	4 30	nil	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Meteor T.7	T.	37	2	43	6	2	Derwent 8	7,000	14,000	40	nil	nil	nil	560	s.l.	30,000	5.6	730
Meteor F.8	F.B.	37	2	44	7	2	Derwent 8	7,000	15,700	44	4 20	2 1,000	16 95	595	10,000	40,000	11.4	690
Meteor F.R.9	F.R.	37	2	43	6	2	Derwent 8	7,000	15,660	44	4 20	nil	nil	595	10,000	40,000	11.4	690
Meteor P.R.10	R.	43	0	44	3	2	Derwent 8	7,000	15,330	40	nil	nil	nil	575	10,000	40,000	10	1,400
Handley Page:																		
Victor B.1	B.	110	0	114	11	4	Sapphire	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Hastings C.2	Tc.	113	0	82	1	4	Hercules 106	6,700	80,000	56.8	nil	nil	nil	348	22,200	10,000	11	2,000
Hawker:																		
Hunter F.4	F.B.	33	8	45	3	1	Avon	n.r.	n.r.	n.r.	4 30	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Hunter F.5	F.B.	33	8	45	3	1	Sapphire	n.r.	n.r.	n.r.	4 30	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Hunter F.6	F.	33	8	—		1	Avon	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Hunter Two-Seater	T.	33	8	48	10½	1	Avon	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Hunting Percival:																		
Provost T.1	T.	35	2	28	8	1	Leonides 25	550	4,300	20.1	2 7.7	8 25	6 60	200	2,300	10,000	7	630
Jet Provost T.1	T.	35	5	31	11	1	Viper 101	1,750	5,950	27.2	nil	nil	nil	323	20,000	30,000	24.4	—
Pembroke C.1	Tc. T.	64	6	46	0	2	Leonides	1,100	13,000	32	nil	nil	nil	220	2,000	10,000	10.5	1,030
Sea Prince T.1	T.	56	0	46	3½	2	Leonides 25	1,100	11,850	32.5	nil	nil	nil	223	2,000	5,000	5.7	530
Miles:																		
Student	T.	28	0	27	0	1	Marboré	880	3,100	22	nil	nil	nil	295	s.l.	20,000	11.3	463
Student	T.	28	0	27	0	2	Palas 600	700	3,100	22	nil	nil	nil	281	s.l.	20,000	16.8	400
Short:																		
S.B.5 (see note 3)	R'ch.	30	6	45	9	1	Derwent	n.r.	n.r.	n.r.	nil	nil	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Sherpa	R'ch.	38	0	31	10½	2	Palas	700	3,125	n.r.	nil	nil	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Seamew A.S.1	A.-S.	55	0	41	8	1	Mamba	n.r.	n.r.	n.r.	nil	4 depth charges	6 R.P.s	n.r.	n.r.	n.r.	n.r.	n.r.
Vickers-Armstrongs:																		
Valiant B.1	B.	114	4	108	3	4	Avon	n.r.	n.r.	n.r.	nil	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Valiant B.2	B.	114	4	114	0	4	Avon RA.14	n.r.	n.r.	n.r.	nil	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Type 1000	Tc.	140	0	146	0	4	Conway	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Varsity T.1	T.	95	6	67	6	2	Hercules 264	3,900	37,500	38.5	nil	24 25	nil	290	5,000	10,000	7.5	1,500
Valetta C.1	Tc.	89	5	63	2	2	Hercules 230	3,950	36,500	41.3	nil	nil	nil	291	10,000	max. r.o.c.—	1,500 ft/min above	1,460
Valetta T.3	T.	89	5	65	3	2	Hercules 230	3,950	36,500	41.3	nil	nil	nil	291	10,000	as	above	1,410
Vickers-Supermarine:																		
Swift F.R.5	F.R.	32	4	42	3	1	Avon	n.r.	n.r.	n.r.	2 30	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Type 525	F.	n.r.		n.r.		2	Avon	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Attacker F.B.2	F.B.	36	11	37	6	1	Nene 102	5,000	11,750	52	4 20	2 1,000	8 60	585	s.l.	30,000	7.1	1,190
N.113	F.B.	n.r.		n.r.		2	Avon	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Westland:																		
Wyvern S.4	Strike	44	0	41	10	1	Python	n.r.	n.r.	n.r.	4 20	2 1,000	16 65	n.r.	n.r.	n.r.	n.r.	n.r.

Abbreviations: A.-S.=Anti-submarine; a.u.w.=all-up weight; B.=bomber; C.=communications; F.=fighter; I.=intruder; i.r.c.=initial rate of climb (ft/min); n.r.=not released; O.=observation; R.=reconnaissance; R'ch.=research; r.o.c.=rate of climb; R.P.=rocket projectile; s.l.=sea level; Tar.=target; T.=training; Tt.=transport; T.T.=target tug. **Notes:** (1) For piston engines, power (in h.p.) is for take-off; for turbojets, thrust (in lb) is static. (2) Bomb and R.P. loads are generally alternatives. (3) Dimensions are for 60 deg sweepback.

BRITISH CIVIL AIRCRAFT 1955

(INCLUDING TYPES NOT YET IN PRODUCTION)

Maker and Type	Span ft in	Length ft in	Power Unit(s) No.	Type	Power (see) note 1)	Normal a.u.w. lb	Wing Loading lb/sq ft	Max. Disposable Load lb	Volumetric Payload Capacity cu ft	No. of Pass.	Cabin Air (see note 2)	Max. Still-Air Range miles	Typical Performance: Distance miles (see note 3)	Height ft	Speed m.p.h.	Payload lb	Representative Field Length (I.S.A.) yd (see note 4)
Auster:																	
Aiglet Trainer ...	32 0	23 2	1	Gipsy Major 1	120	1,850	11.3	877	—	1/2	—	—	275	1,000	109	—	330
Autocar	32 0	23 2	1	Cirrus Major 3	140	2,450	13.3	1,091	62	3	—	—	520	1,000	110	650	380
Aviation Traders:																	
Accountant ...	82 6	60 6	2	Dart 510	3,480	28,000	40	12,360	1,625	28/36	P.	—	604	20,000	285	7,800	1,013(c)
Blackburn:																	
Universal Freighter ...	162 0	99 2	4	Centaurus 673	11,400	135,000	46.4	55,766	7,100	130	—	3,680	200	8,000	180	46,300	1,180(c)
Bristol:																	
Type 170 Mk 31E	108 0	68 4	2	Hercules 734	3,960	44,000	30	14,617	2,360	44	—	1,730	850	5,000	166	10,000	825
Type 170 Mk 32 ...	108 0	73 6	2	Hercules 734	3,960	44,000	30	12,200	3,000	(see note 5)	—	1,730	850	5,000	166	8,352	825
Britannia 100 ...	142 3½	114 0	4	Proteus 705	15,120	150,000	73	68,000	—	83	P.	6,300	4,100	29,400	340	25,000	1,850(c)
Britannia 300 ...	142 3½	124 3	4	Proteus 755	16,480	155,000	75.5	75,000	—	99	P.	(see note 6)	3,800	30,200	350	30,000	1,800(c)
de Havilland:																	
Airspeed Ambassador ...	115 0	82 0	2	Centaurus 661	5,250	55,000	45.8	16,276	2,540	47	P.	1,660	470	15,000	253	9,950	1,570(c)
Comet 4	115 0	111 6	4	Avon RA.29	42,000	152,500	71.4	—	—	58/76	P.	—	2,700	42,000	500	19,300	2,380(c)
Dove 5	57 0	39 3	2	Gipsy Queen 70, Mk 2	760	8,800	26.3	2,420	392	11	—	1,153	490	8,000	179	1,672	810
Heron 2	71 6	48 6	4	Gipsy Queen 30, Mk 2	1,000	13,000	26	—	586	11/17	—	1,375 (see note 7)	690	8,000	183	2,926	865(c)
Handley Page:																	
Hermes	113 0	96 10	4	Hercules 763	8,400	86,000	61.1	30,650	3,754	40/60	P.	3,430	1,345	10,000	268	17,000	1,700(c)
Marathon ...	65 0	52 1½	4	Gipsy Queen 70, Mk 4	1,360	18,250	36.14	5,972	1,010	18/20	—	1,020	940	5,000	167	3,740	920
Herald	95 0	70 3	4	Leonides Major	3,480	34,000	38.55	12,325	—	44	P.	2,175	500	10,000	194	10,165	666(c)
Hunting Percival:																	
Prince III	56 0	42 10	2	Leonides 24	1,100	11,000	30.2	3,190	620	8/12	—	1,107	650	5,000	151	1,660	800
New Prince V ...	64 6	46 0	2	Leonides 503/4	1,080	12,500	31	4,000	—	12	—	1,160	650	8,000	150	2,090	1,265(c)
Miles:																	
Aries	36 2	22 3	2	Cirrus Major 3	310	3,475	18	—	—	4	—	675	500	1,000	150	650	425
Saunders-Roe:																	
Princess	219 6	148 0	6	B.E.25	30,270	345,000	65	137,000	13,500	130	P.	6,000+	4,700	32,000	358	40,385	2,780
Scottish Aviation:																	
Prestwick Pioneer 2 ...	49 9	34 6	1	Leonides 502/4	520	5,800	14.9	—	80	4	—	420	350	5,000	121	1,300	230
Twin Pioneer ...	76 6	45 1	2	Leonides 502/1	1,100	13,500	20.5	4,425	—	14/16	—	620	565 (s)	5,000	139	3,008	342
Vickers-Armstrongs:																	
Viscount 700D ...	93 8½	81 2	4	Dart 510	6,960	60,000	60.75	25,425	2,474	40/53	P.	(see note 8)	1,400	20,000	321	10,000	1,553(c)
Viscount 800 ...	93 8½	85 0	4	Dart 510	6,960	62,000	64.3	—	—	44/70	P.	—	660	20,000	315	14,000	1,860(c)
V.C.7	140 0	146 0	4	Conway	52,000	250,000	—	—	—	120	P.	—	—	—	—	—	—

Notes: (1) For piston engines, power (in h.p.) is for take-off; for turboprops, an equivalent shaft horsepower is given; for turbojets, thrust (in lb) is static. (2) P = pressurized. (3) Where possible, a typical stage-length with allowances is given; (s) indicates still-air range. (4) Distance accompanied by (c) includes allowance for engine-out. (5) 20 passengers and three cars. (6) The maximum range of the Britannia 100 with full tanks and 15,000 lb payload is 5,270 miles; corresponding figures for the Britannia 300 are 5,180 miles with 18,000 lb (standard tankage) and 6,100 miles with 16,000 lb (L.R. version). Gross weight of the latter version will be 170,000 lb. (7) Stage-length with five passengers and baggage. (8) 2,410 miles with slipper tanks; 2,190 miles with standard tankage.

HELICOPTERS

Maker and Type	Main Rotors	Rotor Diam. ft in	Fuselage Length ft in	Power Unit(s) No.	Type	Power h.p.	a.u.w. lb	Disc Loading lb/sq ft	Disposable Load lb	No. of Pass.	Typical Performance: Range miles	Height ft	Speed m.p.h.	Payload lb
Bristol:														
Type 171 Mk 4 (Sycamore) ...	1	48 6.7	42 0	1	Leonides	545	5,400	2.87	1,390	3/4	270	s.l.	91	706
Type 173 Mk 1	2	48 6.7	55 1.7	2	Leonides Le.23 H.M.V. ...	1,090	10,600	2.86	2,800	10	100	2,500	85	1,200
Type 191	2	48 6	50 2.7	2	Leonides Major ...	1,740	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Hunting Percival:														
P.74	1	55 3½	31 0	1	Oryx NOr.1 ...	750	7,750	—	—	8	—	—	—	—
P.105	1	60 3½	37 7	2	Oryx NOr.4 ...	1,650	—	—	—	10	150	s.l.	100	—
Saunders-Roe:														
Skeeter 6	1	32 0	28 5	1	Gipsy Major 200	200	2,150	2.6	—	1	—	See note 1		—
Westland-Sikorsky:														
S-51 (Dragonfly)	1	49 0	41 1.75	1	Leonides 521/1 ...	520	5,700	3.15	1,073	3	200	up to 4,000	80	653
S-55 (Whirlwind)	1	58 0	41 8.5	1	Wasp R-1340 ... or Wright R-1300	600 or 700	7,500	3.4	2,240	10	200	up to 6,200	90	1,598
Widgeon	1	—	—	1	Leonides	545	5,900	—	—	4	—	—	—	—

Notes: (1) Max speed is 106 m.p.h. and endurance 3.3 hr.

THE MINISTRY'S CONTRIBUTION

—to the S.B.A.C. Display: Kinetic Heating and Jet Flaps

THE work of the Royal Aircraft Establishment, the National Gas Turbine Establishment and the Technical Information Services will be typified on the Ministry of Supply Stand at Farnborough next week.

The R.A.E. exhibits are presented by the Structures Department under the theme "structural research methods." To demonstrate kinetic heating infra-red lamps have been selected. The size of these can be small and convective losses low; there is no delay in gaining full power, with a certainty of transmission to the structure. Quartz tubes for the lamp improve transmission whilst the dull black surface of the specimen aids absorption of the heat energy. Pyrometers have been devised for measurement of the heat flux. A simulator has been developed to compare theoretical and actual heat inflows, using known aerodynamic data and observed surface conditions, and it utilizes an assembly of lamps to which power is servo-controlled by the heat inflow error signal. The equipment will be demonstrated using a typical specimen but applying relatively low-density heating—approximately one-tenth of maximum proposed.

A model will show a typical test installation in which a mechanical loading system is augmented by heating equipment. Both mechanical and thermal loadings are applied simultaneously in a time-dependent manner. Incidentally, the quartz tubular infra-red filament heater to be shown in this display is so highly powered for its size that sufficient to operate all the possible electrical services of five homes can be concentrated into one square foot.

To demonstrate the use of flutter-test equipment a wing will be displayed mounted on a part of a wall of the working section of a supersonic wind-tunnel. The wing flutters in modes of elastic distortion and pitch about an axle fitted in the tunnel wall at the wing root. Under test the wing-pitching stiffness is reduced until flutter occurs at the tunnel operating conditions. The oscillatory motion of the wing is displayed on an oscilloscope and recorded on a moving film. A safety catch is fitted which automatically clamps the wing before its flutter amplitude becomes excessive.

The third exhibit will illustrate rocket technique for measuring wing forces whereby the wings are hinged to a rocket body and pitch about an upstream axis against a spring restraint. The wings are oscillated at intervals during the rocket flight and a telemetry sender, on the rocket, transmits information on the wing oscillations to the ground. From a knowledge of the frequency and rate of decay of the wing oscillations the required aerodynamic derivatives can be determined.

There will be, also, a representation of how records of complex vibrations associated with flutter and buffeting are recorded by a multi-channel recorder of a variable-area-photographic type.

Other notable items will be the latest models of the compound counting accelerometer and fatigue meter, both designed at the R.A.E. The compound counting accelerometer is used to obtain gust data. A camera records at regular intervals the airspeed, altitude and vertical accelerations imposed on the aircraft, and with a knowledge of the latter's aerodynamic character it is possible to convert the data obtained and to show magnitude and frequency of occurrence of gusts at varying altitudes. The fatigue meter is a scaled-down counting accelerometer; it measures the number of times certain specified accelerations are exceeded during the life of the aircraft.

A working model will show in sectional form the wings of an aircraft passing through flexible seals in the walls of a fatigue-test tank and a series of hydraulic jacks to apply wing loadings.

The National Gas Turbine Establishment will feature the jet flap. In this arrangement the propulsive jet or, if the machine be airscrew-driven, the gas-turbine effluent, would be discharged from the rear of the wing in the form of a long thin spanwise sheet as shown. In high-speed flight the jet would issue horizontally so that the machine would behave more or less like any other. In low-speed flight it would be inclined downwards as will be shown, and so, after the fashion of a large conventional flap, would generate very high lift on the wing. The magnitude of this lift will readily be grasped by comparing two photographs illustrating the flow around the same wind-tunnel model with and without its jet at a downward inclination of 58 degrees. Since the arrangement is essentially a type of flap, it requires forward motion and so cannot be used for vertical take-off, but only for the reduction of take-off and landing speeds.

Representing the work of the Technical Information Bureau will be a selection of M.o.S. unpublished reports; information on their availability will be given on request. Reports published by H.M.S.O. originating from the Ministry of Supply will also be on view. Specimen copies of *Index Aeronauticus* and the list of journals abstracted, bibliographies produced in T.I.B., and catalogues of special report collection will be available for consultation by visitors.

Information will be available on the activities of the Central Radio Bureau, which is concerned with electronics information and provides a collecting and distributing service for Government departments, and on the Technical Mission in Washington, which maintains liaison with the U.S.A. on matters of mutual interest.

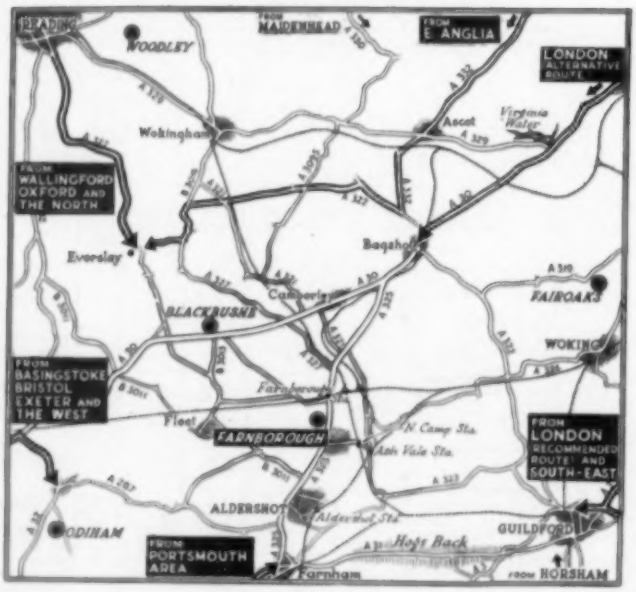
Farnborough: a Visitors' Guide

THE following information is mainly for the guidance of intending visitors to the S.B.A.C. Flying Display on the three "public" days, Friday, Saturday and Sunday, September 9-11th, since those attending on the first four days will be there by invitation or other special means of admission. On the public days, the gates will open at 10 a.m. and flying will begin at 3 p.m.—half-an-hour later than on the trade days. As detailed on p. 250 of our issue of August 19th, the programme will be divided into six "circus" groups followed by 20 individual demonstrations.

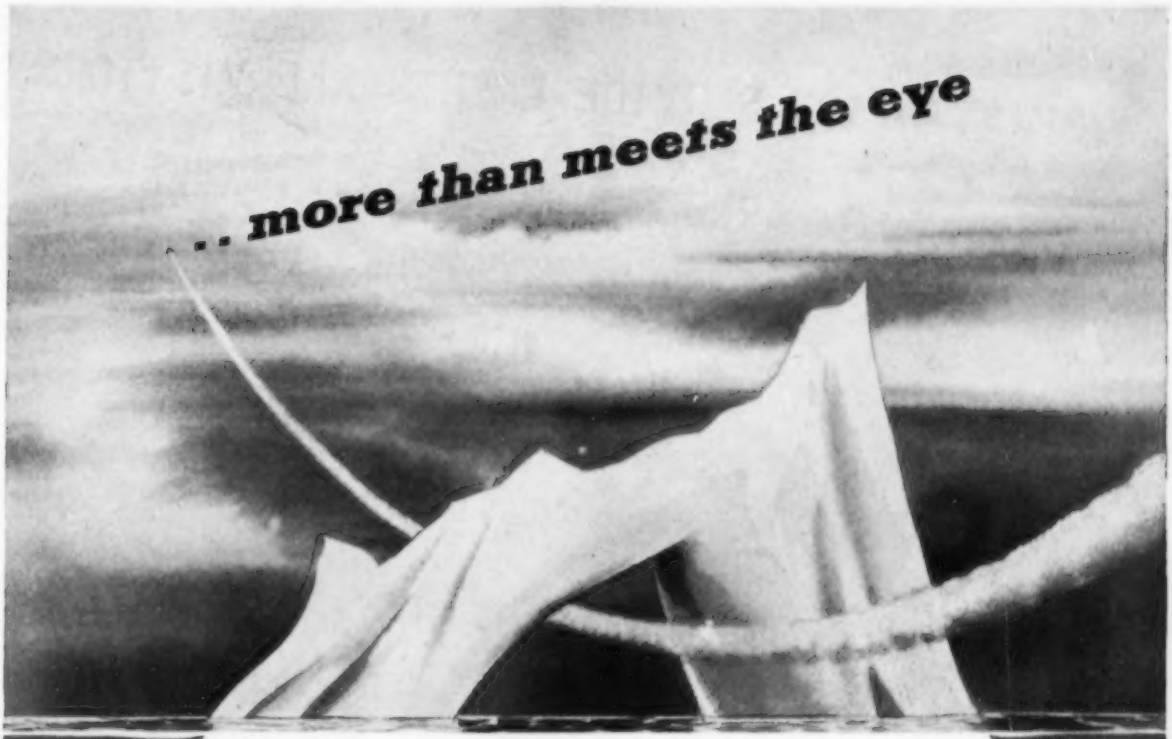
On Friday, the public première, admission prices will be: adults, £1; children under 14, 10s; cars, £1 (plus fees for occupants); motor coach parking, £1. On the Saturday and Sunday the admission charges are: adults, 5s; children, 2s 6d; cars, £1 10s (including six occupants, excess passengers at normal fees); motor cycle parking, 2s 6d; coach parking, 10s. Tickets *for the Friday only* may be obtained in advance from Autoparks, Ltd., 1-31 Maclise Road, London, W.14.

Approach routes to Farnborough are shown on the accompanying map. As traffic is heavy, particularly on the Saturday and Sunday, visitors by road are asked strictly to observe the R.A.C. signposting, which begins on the various routes at the points marked by arrows on the map.

As regards public transport facilities, the Aldershot and District Traction Company have arranged for a high-frequency service of buses between Farnborough main railway station and the airfield and between Farnborough North station and the airfield. In addition, and in conjunction with the augmented



Recommended routes: from the points arrowed, roads are R.A.C.-signposted. The nearest civil airfield is Blackbushe.



Much more of an iceberg lies beneath the sea's surface than is visible above it. At Farnborough Air Show too, what is seen in the sky, although the summit of achievement, is merely representative of a vast productive organisation in the background, constantly active at drawing board, at factory bench, in assembly shop.

Such an organisation is the Saunders-Roe Group. By virtue of sound production capacity, long experience in the successful handling of sizeable contracts, and the habit of full and prompt delivery, it is geared to the manufacturing needs of both civil and military aircraft, land or water-based, on a modern, high-pressure scale. Its designers and researchers, moreover, given the greatest freedom and encouragement to experiment and develop new ideas, are ceaselessly at work in the creative field.

This is all in the authentic tradition of Saunders-Roe. Since the early days of flying, its history has been one of expanding technical achievement blended with growing production capacity in all fields of aircraft manufacture and design. Most noticeably was this so during the war, when nearly 1,600 aircraft were built, repaired and adapted. Among these were over 750 new amphibians.

Today the vital part which Saunders-Roe plays in the construction of B.E.A. Viscounts, passenger 'planes for Air France, patrol boats of the 'Dark' class and with its 'Skeeter' helicopters, reveals the weight of its productive potential and the range of its technical scope. In the Isle of Wight, at Eastleigh and at Anglesey, it can grapple comprehensively at short notice with any large assignment of national significance.

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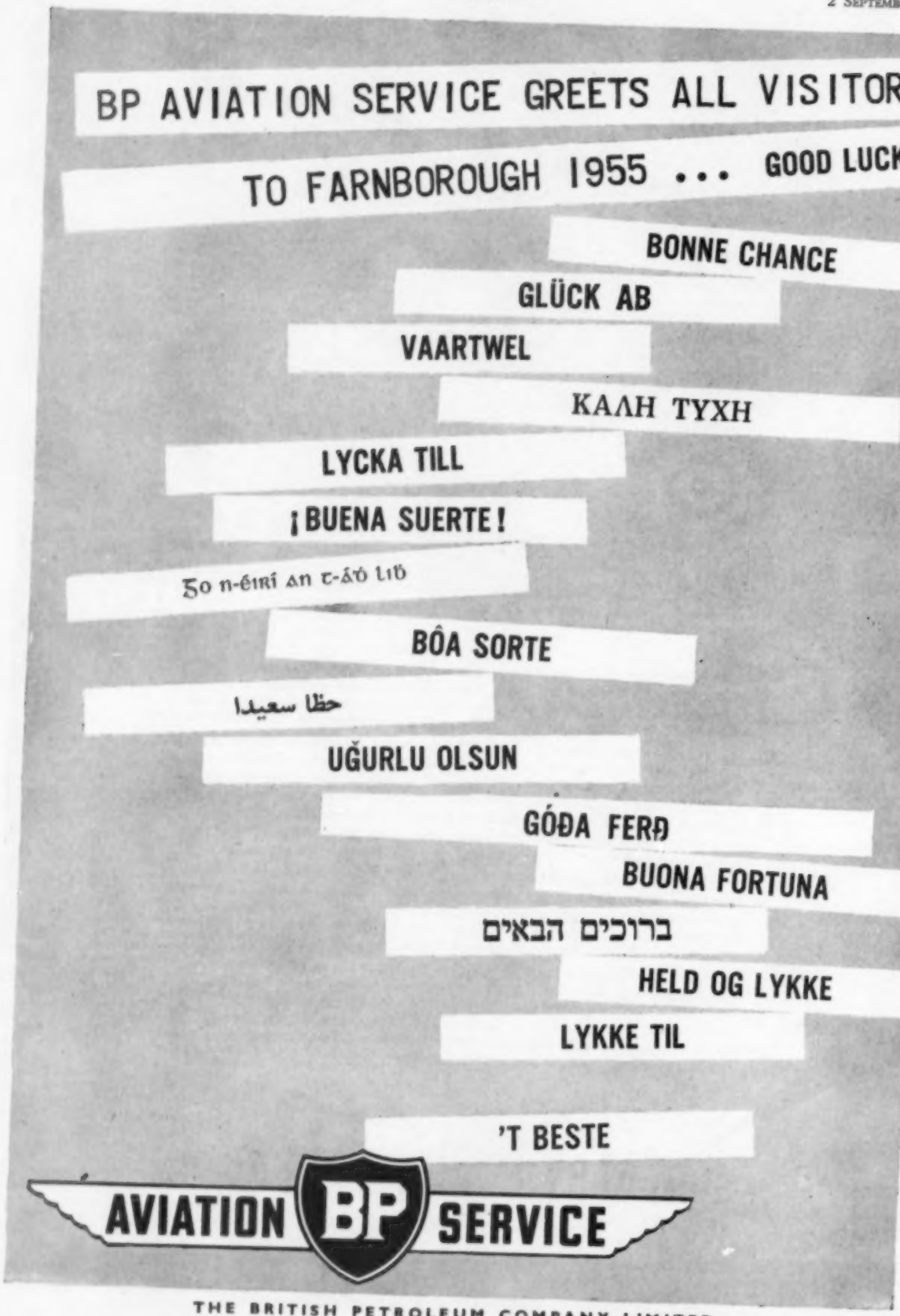

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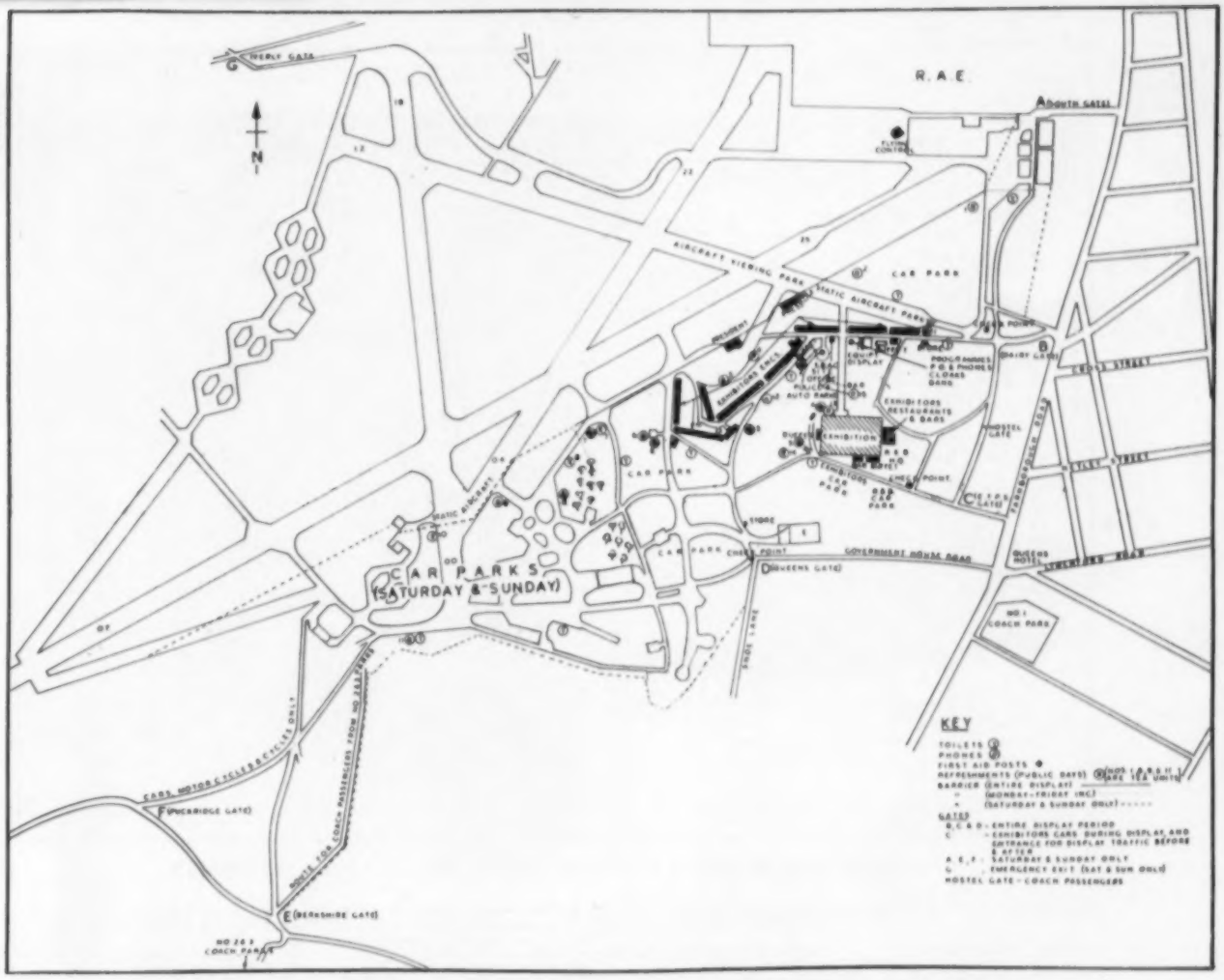


This S.B.A.C. official map shows the general layout of the airfield facilities for both the trade and public days.

FARNBOROUGH: A VISITORS' GUIDE . . .

rail services which will be provided by British Railways Southern Region, the bus company will operate very-high-frequency special services between Aldershot station and the airfield and North Camp station and the airfield. The company also runs a regular half-hourly coach service from Victoria Station to Farnham, with a stopping point at the airfield; intending passengers on this route are strongly advised to book their seats in advance.

British Railways state that their normal services from Waterloo to Aldershot—the journey takes about an hour—"will be augmented as necessary." In connection with the Show, they have arranged for combined rail and bus cheap day tickets (returning by any train on the same day) from numerous stations to Farnborough airfield. Details are obtainable at local stations.

Above is a plan of the airfield as laid out for the Display, clearly showing the disposition of the various enclosures, parking spaces and public facilities. On p. 412 is a floor plan of the "static" show, indicating the positions of the 307 stands listed below.

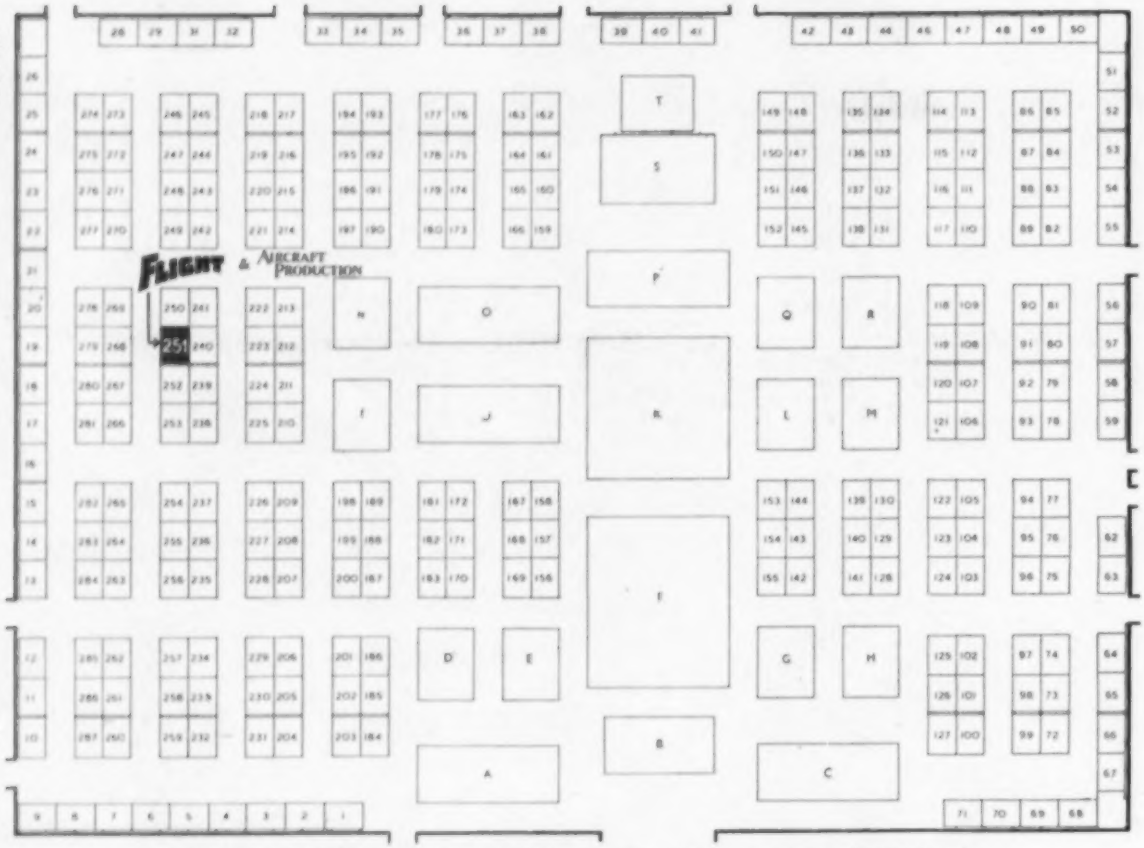
EXHIBITORS' STAND NUMBERS

AIRCRAFT AND ENGINE MANUFACTURERS

Alvis, Ltd.	E
Auster Aircraft, Ltd.	L
Blackburn and General Aircraft, Ltd.	J
Boulton Paul Aircraft, Ltd.	T
Bristol Aeroplane Co., Ltd., The	P
De Havilland Enterprise, The	K
English Electric Co., Ltd., The	C
Fairey Aviation Co., Ltd., The	O
Folland Aircraft, Ltd.	N
Handley Page, Ltd.	A
Hawker Siddeley Group, Ltd., The	F
Hunting Percival Aircraft, Ltd.	H
Ministry of Supply	R
Napier and Son, Ltd., D.	G
Rolls-Royce, Ltd.	B
Saunders-Roe, Ltd.	Q
Scottish Aviation, Ltd.	M
Short Brothers and Harland, Ltd.	D
Vickers-Armstrongs, Ltd.	S
Westland Aircraft, Ltd.	I

MATERIALS, COMPONENTS, ACCESSORIES, ETC.

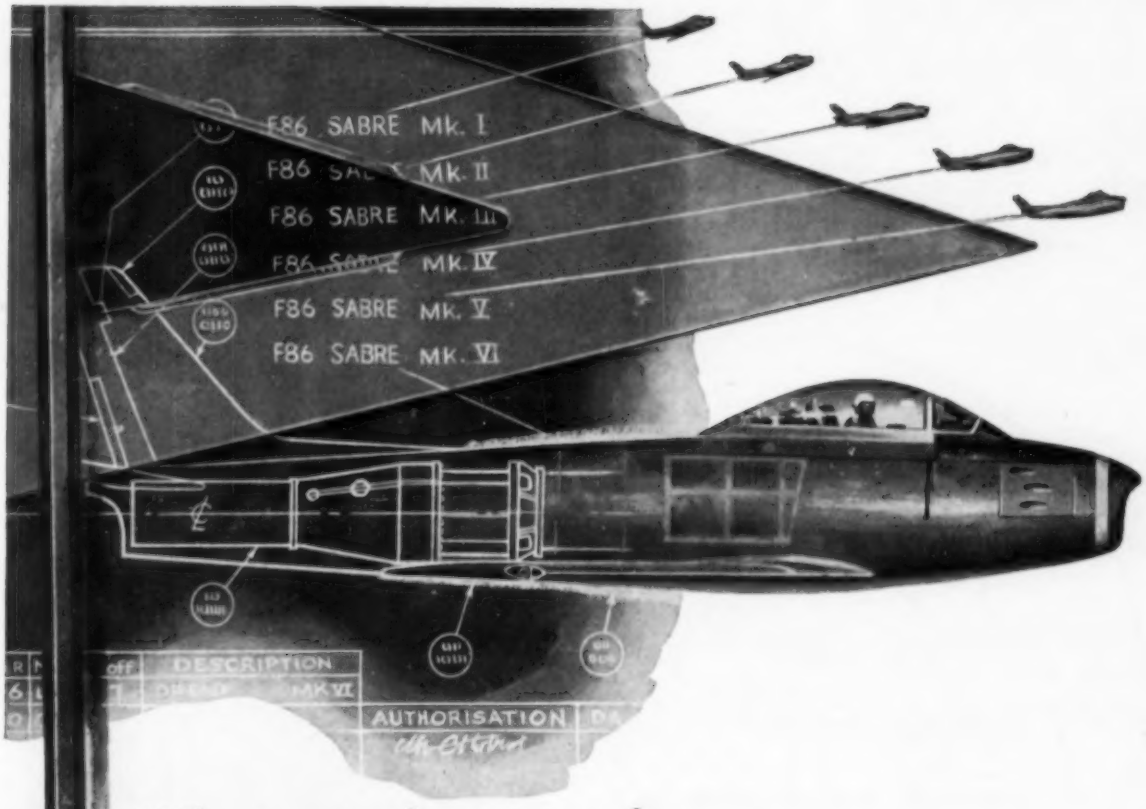
Accles and Pollock, Ltd.	142
Acratork Engineering Co., Ltd.	262
Acton Bolt, Ltd.	143
Aero Controls, Ltd.	86
Aeronautics	244
The Aeroplane	69
Aeroplastics, Ltd.	163
Aero Research, Ltd.	83
Aircraft Engineering	112
Aircraft Materials, Ltd.	198
Airscrew Co. and Jicwood, Ltd.	8
Air Trainers, Ltd.	195
Airwork General Trading Co., Ltd.	34
Aldis Bros., Ltd.	49
Amalgamated Wireless (Australasia), Ltd.	25
Ashdowns, Ltd.	270
Attewell and Sons, Ltd., B.	55
Auto Diesels, Ltd.	274
Automotive Products, Ltd.	58
Avery Hardoll, Ltd.	253
Aviation Developments, Ltd.	68
Aviation Traders (Engineering), Ltd.	278
Avica Equipment, Ltd.	225
Bakelite, Ltd.	50
Bell's Asbestos and Engineering, Ltd.	186
Belling and Lee, Ltd.	273
Birmetals, Ltd.	145
Birmingham Aluminium Casting (1903) Co., Ltd.	119
Bloctube Controls, Ltd.	192
Boorn and Co., Ltd., Thos.	204
Booth and Co., Ltd., James	101
Bowden (Engineers), Ltd.	282
Brand and Co., Ltd., R. A.	228
Brent Chemical Products, Ltd.	283
Briggs Motor Bodies, Ltd.	19
British Artid Plastics, Ltd.	220
British Aluminium Co., Ltd.	36
British Belting and Asbestos, Ltd.	75
British Ermeto Corporation, Ltd.	104
British Emulsifiers, Ltd.	79
British Insulated Callender's Cables, Ltd.	160
British Manufacture and Research Co., Ltd.	15
British Manufactured Bearings Co., Ltd.	76
British Messier, Ltd.	21
British Oxygen Co., Ltd., The	179
British Petroleum Co., Ltd., The	91
British Thomson-Houston Co., Ltd.	153
Brown Bros. (Aircraft), Ltd.	157
Brown and Sons (Huddersfield), Ltd., David	250
Brown Bayley Steels, Ltd.	81
Brown, Ltd., S. G.	191
Bryans Aeroquipment, Ltd.	11
Burgess Products Co., Ltd.	230
Burndept, Ltd.	285
Canadian Marconi Co.	23
Cellon, Ltd.	184
Cementation (Muffelite), Ltd.	275
Chesterfield Tube Co., Ltd.	279
Chloride Batteries, Ltd.	118
Cole, Ltd., E. K.	258
Connolly Bros. (Curriers), Ltd.	99
Coopers Mechanical Joints, Ltd.	57
Cossor, Ltd., A. C.	63
Curran, Ltd., John	150
Decca Navigator Co., Ltd.	53
Decca Radar, Ltd.	54
Delaney Gallay, Ltd.	181
Desoutter Bros., Ltd.	210
Docker Bros.	190
Dowty Equipment, Ltd.	31
Dowty Equipment of Canada, Ltd.	32
Dowty Fuel Systems, Ltd.	29
Dowty Seals, Ltd.	28
Dragonair, Ltd.	37
Dunlop Rubber Co., Ltd.	43
Dunlop Special Products, Ltd.	42
Dzus Fasteners (Europe), Ltd.	82
E.N.V. Engineering Co., Ltd.	123
Eastern Aero Electrical Services, Ltd.	224
Ekco Electronics, Ltd.	257
Electro-Hydraulics, Ltd.	211
Elliott Bros. (London), Ltd.	218
English Electric Co., Ltd.	22
English Steel Corporation, Ltd.	154
Essex Aero, Ltd.	281
Esso Petroleum Co., Ltd.	72
Exactor, Ltd.	189
Export Packing Service, Ltd.	105
Fairey Aviation Co. of Australia Pty., Ltd.	165
Fairey Aviation Co. of Canada, Ltd.	164
Ferranti, Ltd.	187
Fibreglass, Ltd.	39
Field Aircraft Services, Ltd.	95
Fielding and Platt, Ltd.	132
Fireproof Tanks, Ltd.	100



Arrangement of the 307 stands in the exhibition marquee, which covers an area of 112,000 sq ft.

EXHIBITORS' STAND NUMBERS (cont.)

Firestone Tyre and Rubber Co., Ltd. 141
Firth-Derihon Stampings, Ltd. ... 175
Firth and John Brown, Ltd., Thos. 174
Firth and Sons, Ltd., T. F ... 78
Firth-Vickers Stainless Steels, Ltd. 213
Flather, Ltd., W. T. 122
Flight and Aircraft Production 251
Flight Refuelling, Ltd. 162
Flint, Ltd., Howard 85
Fothergill and Harvey (Sales), Ltd. 177
Fox and Co., Ltd., Samuel ... 146
Frankenstein and Sons (Manchester), Ltd., P. 62
French and Sons, Ltd., Thos. ... 233
G. Q. Parachute Co., Ltd. ... 67
Garringtons, Ltd. 116
Gear Grinding Co., Ltd. 215
General Electric Co., Ltd., The ... 197
Girling, Ltd. 16
Gloster Engineering (Cheltenham), Ltd. 231
Godfrey and Partners, Ltd., Sir George 126
Goodmans Industries, Ltd. ... 245
Goodyear Tyre and Rubber Co. (Great Britain), Ltd. 209
Grassby Instruments, Ltd. ... 247
Greviner Manufacturing Co., Ltd. 168
Guest, Keen and Nettlefolds (Midlands), Ltd. 166
Habershon and Sons, Ltd., J. J. ... 217
Hadfields, Ltd. 276
Hairlok Co., Ltd. 77
Hall and Hall, Ltd. 94
Hall and Pickles, Ltd. 56
Hall and Sons (Bristol and London), Ltd., John 5
Harley Aircraft Landing Lamps ... 10
Heenan and Froude, Ltd. ... 133
Hellermann, Ltd. 205
Henley's Telegraph Works Co., Ltd., W. T. 135
Hepworth and Grandage (Yeadon), Ltd. 108
High Duty Alloys, Ltd. 152
High Pressure Components, Ltd. 17
Hobson, Ltd., H. M. 172
Hordern-Richmond, Ltd. 103
Hughes Johnson Stampings, Ltd. 65
Hymatic Engineering Co., Ltd. ... 125
Imperial Chemical Industries, Ltd. (Metals Division) 96
Imperial Chemical Industries, Ltd. (Paints Division) 128
Imperial Chemical Industries, Ltd. (Plastics Division) 102
Integral, Ltd. 171
Irving Air Chute of Great Britain, Ltd. 13
Jablo Propellers, Ltd. 144
Jessop and Sons, Ltd., William ... 48
K.L.G. Sparking Plugs, Ltd. ... 4
Kaye, Ltd., E. and E. 219
Kelvin and Hughes (Aviation), Ltd. 3
Kenilworth Manufacturing Co., Ltd. 255
Kent Alloys, Ltd. 271
Kidde and Co., Ltd., Walter ... 194
King Aircraft Corporation ... 9
Lancefield Aircraft Components, Ltd. 203
Lansing Bagnall, Ltd. 114
Latex Upholstery, Ltd. 35
Laycock Engineering, Ltd. ... 272
Lep Transport, Ltd. 238
Lockheed Hydraulic Brake Co., Ltd. 59
Lodge Plugs, Ltd. 159
Long and Hambly, Ltd. 148
Lucas (Gas Turbine Equipment), Ltd., Joseph 235
Lucas (Batteries), Ltd., Joseph ... 243
Lucas-Rotax, Ltd. 236
M.H.M. Engineering Co., Ltd. ... 277
M.L. Aviation Co., Ltd. 46
McMichael Radio, Ltd. 140
Magnesium Elektron, Ltd. ... 180
Manchester Oil Refinery, Ltd. ... 261
Marconi Instruments, Ltd. ... 26
Marconi's Wireless Telegraph Co., Ltd. 24
Marston Excelsior, Ltd. 139
Martin-Baker Aircraft Co., Ltd. 93
Mechanism, Ltd. 280
Mellor Engineering Co., Ltd. ... 74
Mond Nickel Co., Ltd. 151
Morris, Ltd., S. O. 232
Mullard, Ltd. (Valve Division) ... 73
Murex Welding Processes, Ltd. ... 161
Murphy Radio, Ltd. 110
Negretti and Zambra, Ltd. ... 199
Newmark, Ltd., Louis 239
Newton Bros. (Derby), Ltd. ... 6
Normalair, Ltd. 40
Northern Aluminium Co., Ltd. ... 117
Oldham and Sons, Ltd. 259
Omes, Ltd. 226
Optical Measuring Tools, Ltd. ... 80
Palmer Tyre, Ltd., The 158
Park, Ltd., R. and J. 185
Partridge, Wilson and Co., Ltd. 240
Peto and Radford 169
Philips Electrical, Ltd. 252
Plessey Co., Ltd. 263
Plessey International, Ltd. ... 264
Precision Rubbers, Ltd. 241
Pressed Steel Co., Ltd. 38
Pye, Ltd. 248
Pyrene Co., Ltd. 149
R.F.D., Ltd. 64
Rawlplug Co., Ltd. 84
Redifon, Ltd. 106
Redwing, Ltd. 249
Reilly Engineering Co., Ltd. ... 196
Renfrew Foundries, Ltd. 130
Reynolds Tube Co., Ltd. 170
Rollason Aerocessories, Ltd. ... 107
Rotax, Ltd. 237
Rotol, Ltd. 20
Rubery Owen and Co., Ltd. ... 212
Ryland Ltd., Llewellyn 127
Salford Electrical Instruments, Ltd. 109
Sanders (Electronics), Ltd., W. H. 223
Sangamo Weston, Ltd. 131
Sankey and Sons, Ltd., Joseph ... 89
Saunders-Roe, Ltd. 137
Saunders Valve Co., Ltd. 208
Savage and Parsons, Ltd. ... 7
Schermuly Pistol Rocket Apparatus, Ltd., The 234
Sciaky Electric Welding Machines, Ltd. 92
Self-Priming Pump and Engineering Co., Ltd. 207
Shell-Mex and B.P., Ltd. 90
Short Bros. and Harland, Ltd. ... 183
Siebe Gorman and Co., Ltd. ... 227
Silentbloc, Ltd. 229
Simmonds Aerocessories, Ltd. ... 121
Skyhi, Ltd. 200
Smiths Aircraft Instruments, Ltd. 2
Smith's Stamping Works (Coventry), Ltd. 47
Sorbo, Ltd. 88
Southern Forge, Ltd. 129
Southern Instruments, Ltd. ... 87
Sparklets, Ltd. 178
Sperry Gyroscope Co., Ltd. ... 70
Standard Insulator Co., Ltd. ... 33
Standard Telephones and Cables, Ltd. (Radio Division) 266
Standard Telephones and Cables, Ltd. (Rectifier Division) ... 267
Standard Telephones and Cables, Ltd. (Transmission Division) ... 268
Standard Telephones and Cables, Ltd. (Industrial Supplies Division) 269
Steel Peech and Tozer, Ltd. ... 147
Sterling Metals, Ltd. 12
Stone and Co. (Charlton), Ltd., J. 201
Stone and Co. (Deptford), Ltd., J. 202
Suntex Safety Glass Industries, Ltd. 134
Super Oil Seals and Gaskets, Ltd. 52
T.I. Aluminium, Ltd. 156
Talbot Stead Tube Co., Ltd. ... 256
Tecalemit, Ltd. 167
Teddington Aircraft Controls, Ltd. 51
Teleflex Products, Ltd. 173
Telegraph Construction and Maintenance Co., Ltd. 286
Thermal Control Co., Ltd. ... 221
Thermo-Plastics, Ltd. 260
Thompson Bros. (Bilston), Ltd. ... 66
Thompson (Engineers), Ltd., Raymond F. 136
Thorn Electrical Industries, Ltd. 113
Tiltman Langley Laboratories, Ltd. 188
Titanine, Ltd. 155
Triplex Safety Glass Co., Ltd. ... 206
Tubes, Ltd. 287
Tufnol, Ltd. 242
Tungum Co., Ltd. 182
Turner Bros. Asbestos Co., Ltd. 193
Ultra Electric, Ltd. 124
Valay Industries, Ltd. 246
Van Moppes and Sons (Diamond Tools), Ltd., L. M. 222
Venner, Ltd. 98
Venner Accumulators, Ltd. ... 97
Vernons Industries, Ltd. 176
Vokes, Ltd. 120
Walker and Co., Ltd., James ... 115
Waymouth Gauges and Instruments, Ltd. 1
Wayne Kerr Laboratories, Ltd. ... 118
Wayne Tank and Pump Co., Ltd. 111
Wellworthy, Ltd. 138
Western Manufacturing (Reading), Ltd. 214
Westinghouse Brake and Signal Co., Ltd. 14
Whitehouse Industries, Ltd. ... 254
Wiggin and Co., Ltd., Henry ... 41
Williamson Manufacturing Co., Ltd. 71
Wilmot-Breeden, Ltd. 216
Wireless Telephone Co., Ltd. ... 265
Xezal Products, Ltd. 44
Zwicky, Ltd. 284



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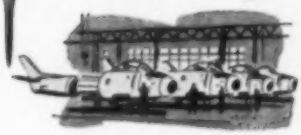

It was recently announced that the latest Canadian-built F86 Sabre jet fighter can fly faster and climb higher than any other aircraft in European squadron service . . . practical evidence of Canadair's superior development and production facilities.

This is the sixth version of this famous fighter which has been produced continuously at Canadair without interruption of scheduled delivery dates. The outstanding record of the Orenda-powered Sabre VI can be credited to the intricate re-engineering of the airframe to take full advantage of the aircraft's new power plant — the Canadian Orenda 14.

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THE ANCILLARY INDUSTRY

Products and Services: A New "Flight" Directory

THIS year we present our annual review of "industry behind the industry" in a new quick-reference form, in which the product rather than the firm is taken as the basis. Thus, in the following pages will be found listed over 300 components, accessories, services, etc., and under each heading are the names of firms whom we understand to be manufacturers or suppliers of such items. Their addresses are listed at the end of the directory. Aircraft and engines are dealt with in detail in the special reviews earlier in this issue. Air-transport operations do not appear in these pages; they have their place in our annual Commercial Aviation Number, published in the spring. Firms exhibiting at the S.B.A.C. Show are, of course, included; a list of stand numbers appears on pages 411-412.

Drop-forging a compressor disc (Firth-Derihon Stampings, Ltd.).

ADDRESSES OF FIRMS: pp. 424-428

A.G.S. PARTS

Accles and Pollock, Ltd.
Acton Bolt, Ltd.
Aerocontacts (Sales), Ltd.
Aero Maintenance Equipment, Ltd.
Aircraft Materials, Ltd.
Aircraft Spares and Components
Air Engine Services (U.S.-U.K.), Ltd.
Aviation Developments, Ltd.
Aviation Traders, Ltd.
Avionics, Ltd.
Baxters (Bolts, Screws and Rivets), Ltd.
British Wire Products, Ltd.
Brown Brothers (Aircraft), Ltd.
Courtney and Co., Ltd., Ross
Cross Manufacturing Co. (1938), Ltd.
Curd Components, Ltd.
Dundas, Ltd., R. K.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Guest, Keen and Nettlefolds (Midlands), Ltd.
Headland, Ltd., Thos. P.
High Pressure Components, Ltd.
Kauter, Ltd.
M.H.H. Engineering Co., Ltd.
Miller Aviation, Ltd.
Newton and Co., H. T.
Newton and Co., Ltd., L. H.
Plessey Group
Powis and Sons, Ltd., David
Reynolds Tube Co., Ltd.
Rollason, Ltd., W. A.
Rolls Razor, Ltd.
Simmonds Aerocessories, Ltd.
Samlesbury Engineering, Ltd.
Stone and Co. (Deptford), Ltd., J.
Tucker Eyelet Co., Ltd., George
Wellington Weston and Co., Ltd.
Walter, A. J.
Westminster Airways Servicing, Ltd.
Whittemore (Aeradio), Ltd., A. J.
Wilmot Breeden, Ltd.
Y.S.C., Ltd., The

ABRASIVES

Morris, Ltd., B. O.
Van Moppes and Sons (Diamond Tools), Ltd., L. M.

ACTUATORS

British Thomson-Houston Co., Ltd., The
Dunlop Rubber Co., Ltd. (Aviation Division)
Eastern Aero Electrical Services, Ltd.
English Electric Co., Ltd.
Graseby Instruments, Ltd.
Hymatic Engineering Co., Ltd., The
M. L. Aviation Co., Ltd.
Miles, Ltd., F. G.
Newton and Co., H. T.
Palmer Tyre, Ltd., The
Plessey Group
Rotax, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Vernons Industries, Ltd.
Western Manufacturing (Reading), Ltd.

ADHESIVES

Aero Research, Ltd.
Aircraft Materials, Ltd.
B. B. Chemical Co., Ltd.
Bakelite, Ltd.
Cox and Son, Ltd., John
Dundas, Ltd., R. K.
Dunlop Special Products, Ltd.
Elliot Equipment, Ltd.
Fireproof Tanks, Ltd.
Goodyear Tyre and Rubber Co. (Great Britain), Ltd., The
Imperial Chemical Industries, Ltd.
Lea Bridge Industries, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Titanine, Ltd.

AERIAL EQUIPMENT, RADIO

Aerocontacts (Sales), Ltd.
Avionics, Ltd.
Baynes Aircraft Interiors, Ltd.
Belling and Lee, Ltd.
Burgess and Co., Ltd., G. H.
Burndept, Ltd.
Chelton (Electrostatics), Ltd.
Cole, Ltd., E. K.
Decca Navigator Co., Ltd., The
Decca Radar, Ltd.
Dundas, Ltd., R. K.
Eagle Aircraft Services, Ltd.
Easipower, Ltd.
Ekco Electronics, Ltd.
Field Aircraft Services, Ltd.
International Aeradio, Ltd.
McMichael Radio, Ltd.
Marconi's Wireless Telegraph Co., Ltd.
Miles, Ltd., F. G.
Murphy Radio, Ltd.
Newton and Co., H. T.
Opperman, Ltd., S. E.
Pye, Ltd.
Racal, Ltd.
Racal Engineering, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

AERODROME MANAGEMENT

Airwork, Ltd.
Aviation Traders (Engineering), Ltd.
Ferry Airports, Ltd.
Flight Refuelling, Ltd.
International Aeradio, Ltd.
Miles, Ltd., F. G.

AGENTS, AIRCRAFT

Aerocontacts (Sales), Ltd.
Aeroservices, Ltd.
Airwork, Ltd.
Aviation Traders (Engineering), Ltd.
Avionics, Ltd.
Derby Aviation, Ltd.
Dundas, Ltd., R. K.
Eagle Aircraft Services, Ltd.
Ferry Airports, Ltd.
Field Aircraft Services, Ltd.
Helicopter Sales, Ltd.
Miles, Ltd., F. G.
Newton and Co., H. T.
Rollason, Ltd., W. A.
Shackleton, Ltd., W. S.
Walter, A. J.
Whittemore (Aeradio), Ltd., A. J.

AIR CONDITIONING AND PRESSURIZATION EQUIPMENT

Aerocontacts (Sales), Ltd.
Avica Equipment, Ltd.
Bell's Asbestos and Engineering, Ltd.
Baynes Aircraft Interiors, Ltd.
Bramah and Co., Ltd., J. R.
de Havilland Propellers, Ltd.
Eagle Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Godfrey and Partners, Ltd., Sir George
Helliwells, Ltd.
Hymatic Engineering Co., Ltd., The
King Aircraft Corporation
M. L. Aviation Co., Ltd.
Marston Excelsior, Ltd.
Normalair, Ltd.
Opperman, Ltd., S. E.
Rollason Aerocessories, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Teddington Aircraft Controls, Ltd.
Westminster Airways Servicing, Ltd.
Vokes, Ltd.

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Atlas Diesel Co., Ltd.
Ross, S. Grahame, Ltd.
Skyhi, Ltd.

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Aeroservices, Ltd.
Aircraft Spares and Components
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Dundas, Ltd., R. K.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Hordern Richmond (Sales), Ltd.
Martin-Baker Aircraft Co., Ltd.
Muir and Adie, Ltd.
Newton and Co., H. T.
Rollason, Ltd., W. A.
Rotol, Ltd.
Shackleton, Ltd., W. S.

ALTERNATORS

Aerocontacts (Sales), Ltd.
British Thomson-Houston Co., Ltd., The
English Electric Co., Ltd.
Newton Brothers (Derby), Ltd.
Newton and Co., H. T.
Plessey Group
Rotax, Ltd.
Rotol, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Vernons Industries, Ltd.

ALUMINIUM AND ITS ALLOYS

Aircraft Materials, Ltd.
Aimin, Ltd.
Birmetals, Ltd.
Booth and Co., Ltd., James
British Aluminium Co., Ltd., The
Dundas, Ltd., R. K.
Headland, Ltd., Thos. P.
High Duty Alloys, Ltd.
Imperial Chemical Industries, Ltd.
Kaye, Ltd., E. and E.
Mills, Ltd., William
Northern Aluminium Co., Ltd.
Stone and Co. (Charlton), Ltd.
T.I. Aluminium, Ltd.
Wilson and Sons (London), Ltd., W.

ARMAMENT (GUNS) AND COMPONENTS

Aerocontacts (Sales), Ltd.
British Manufacture and Research Co., Ltd.
Dunlop Rubber Co., Ltd. (Aviation Division)
Ferranti, Ltd.
French and Sons, Ltd., Thomas
Jameson Aero Engines, Ltd.
M. L. Aviation Co., Ltd.
Opperman, Ltd., S. E.
Stewart Aeronautical Supply Co., Ltd.

ARMAMENT (OTHER THAN GUNS) AND COMPONENTS (see also Missiles, Guided)

Aviation Traders (Engineering), Ltd.
Avica Equipment, Ltd.
Boulton Paul Aircraft, Ltd
Brown, Ltd., S. G.
Chinn and Co., Ltd., J. S.
de Havilland Propellers, Ltd.
Dunlop Rubber Co., Ltd. (Aviation Division)
French and Sons, Ltd., Thomas
Graseby Instruments, Ltd.
Hadfields, Ltd.
Martin-Baker Aircraft Co., Ltd.
Miles, Ltd., F. G.
Pullin and Co., Ltd., R. B.
Stewart Aeronautical Supply Co., Ltd.

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British Belting and Asbestos, Ltd.
Delaney Gallay, Ltd.
Miles, Ltd., F. G.
Thermo-Plastics, Ltd.
Turner Brothers Asbestos Co., Ltd.
Walker and Co., Ltd., James

ASSEMBLIES, MAJOR AIRFRAME

Aeroservices, Ltd.
Aircraft Engineering and Jigs, Ltd.
Aircraft Spares and Components
Airflow Streamlines, Ltd.
Corner and Co., Ltd., G.
Cornercroft, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Helliwells, Ltd.
Heston Aircraft Co., Ltd., The
Hunting Percival Aircraft, Ltd.
Miles, Ltd., F. G.
Newton and Co., H. T.
Portsmouth Aviation, Ltd.
Pressed Steel Co., Ltd.
Rollason Aerocessories, Ltd.
Rollason, Ltd., W. A.
Samlesbury Engineering, Ltd.
Scottish Aviation, Ltd.
V. P. Sheet Metal, Ltd.
Walter, A. J.
Welsh Metal Industries, Ltd.

ASSEMBLIES, SUB-

Accles and Pollock, Ltd.
Aircraft Engineering and Jigs, Ltd.
Aircraft Spares and Components
Airflow Streamlines, Ltd.
Aviation Traders (Engineering), Ltd.
Avica Equipment, Ltd.
Avionics, Ltd.
Bramah and Co., Ltd., J. R.
British Emulsifiers, Ltd.
Brown, Ltd., S. G.
Burgess and Co., Ltd., G. H.
Chinn and Co., Ltd., J. S.
Corner and Co., Ltd., G.
Cornercroft, Ltd.
Dart Aircraft, Ltd.
Delaney Gallay, Ltd.
Dent and Co. and Johnson, Ltd.
Easipower, Ltd.
Essex Aero, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Helliwells, Ltd.
Henderson Safety Tank Co., Ltd., The
Heston Aircraft Co., Ltd., The
King Aircraft Corporation
Leytonstone Jig and Tool Co., Ltd.
Miles, Ltd., F. G.
Newton and Co., H. T.
Opperman, Ltd., S. E.
Pressed Steel Co., Ltd.
Pullin and Co., Ltd., R. B.
R.F.D. Co., Ltd.
Redwing, Ltd.
Reilly Engineering, Ltd.
Reynolds Tube Co., Ltd.
Rollason Aerocessories, Ltd.
Rolls Razor, Ltd.
Samlesbury Engineering, Ltd.
Sankey and Sons, Ltd., Joseph
Scottish Aviation, Ltd.
Skyways, Ltd.

(Continued overleaf)

THE ANCILLARY INDUSTRY . . .

Assemblies, Sub- (Continued)
Tiltman Langley, Ltd.
V.P. Sheet Metal, Ltd.
Welsh Metal Industries, Ltd.
Western Manufacturing (Reading), Ltd.
Westminster Airways Servicing, Ltd.
Whittemore (Aeradio), Ltd., A. J.
Wilmot Breeden, Ltd.

AUTOMATIC PILOTS
A.J.W. (Instruments), Ltd.
Dundas, Ltd., R. K.
Elliott Brothers (London), Ltd.
M.L. Aviation Co., Ltd.
Newton and Co., H. T.
Smiths Aircraft Instruments, Ltd.
Sperry Gyroscope Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.

AUXILIARY POWER UNITS
Aero Maintenance Equipment, Ltd.
Aerocontacts (Sales), Ltd.
Aircraft Spares and Components
British Thomson-Houston Co., Ltd., The
Partridge, Wilson and Co., Ltd.
Pethow, Ltd.
Plessey Group
Rollason Engines, Ltd.
Rotol, Ltd.
Rover Gas Turbines, Ltd.
Sugg Solar, Ltd.
Vernons Industries, Ltd.

BAGS, COTTON (For spares, etc.)
Feltham and Son, Ltd., Walter H.

BALLOONS
Aerocontacts (Sales), Ltd.
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Elliot Equipment, Ltd.
Lea Bridge Industries, Ltd.
R.P.D. Co., Ltd.
Suchy Holdings Group

BARRIER CREAMS
Rozalex, Ltd.

BATTERIES
Aerocontacts (Sales), Ltd.
Avionics, Ltd.
Burndept, Ltd.
Chloride Batteries, Ltd.
Dundas, Ltd., R. K.
Eastern Aero Electrical Services, Ltd.
Field Aircraft Services, Ltd.
Newton and Co., H. T.
Oldham and Son, Ltd.
Peto and Radford, Ltd.
Rollason, Ltd., W. A.
Stewart Aeronautical Supply Co., Ltd.
Varley Dry Accumulators, Ltd.
Venner Accumulators, Ltd.
Walter, A. J.
Whittemore (Aeradio), Ltd., A. J.

BEARINGS
Aero Controls, Ltd.
Aircraft Materials, Ltd.
Aircraft Spares and Components
Autoset (Production), Ltd.
Birkett, Billington and Newton, Ltd., T. M.
British Timken, Ltd.
Dundas, Ltd., R. K.
E.M.O. Instrumentation, Ltd.
Field Aircraft Services, Ltd.
Fischer Bearings Co., Ltd.
Glacier Metal Co., Ltd., The
Mollart Engineering Co., Ltd., The
Newton and Co., H. T.
Ransome and Marles Bearing Co., Ltd.
Rollason Engines, Ltd.
Salter and Co., Ltd., Geo.
Silentbloc, Ltd.
Skefco Ball Bearing Co., Ltd., The
Stewart Aeronautical Supply Co., Ltd.
Stone and Co. (Charlton), Ltd., J.
Tufnol, Ltd.
Vandervell Products, Ltd.
Walter, A. J.
Yorkshire Engineering Supplies, Ltd.

BELTING
Bell's Asbestos and Engineering, Ltd.
Goodyear Tyre and Rubber Co. (Great Britain), Ltd., The
Turner Brothers Asbestos Co., Ltd.

BELTS, PASSENGER SEAT
Aerocontacts (Sales), Ltd.
Baynes Aircraft Interiors, Ltd.
Bell's Asbestos and Engineering, Ltd.
Field Aircraft Services, Ltd.
Latex Upholstery, Ltd.
Newton and Co., H. T.
Rollason, Ltd., W. A.
Rumbold and Co., Ltd., L. A.
Siebe, Gorman and Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.

BLADES, GAS TURBINE
B.R.D. Co., Ltd.
Firth-Derihon Stampings, Ltd., The
Firth and John Brown, Ltd., Thos.
Garringtons, Ltd.
Hadfields, Ltd.
Hepworth and Grandage (Yeadon), Ltd.
High Duty Alloys, Ltd.
Jessop and Sons, Ltd., William
Omes, Ltd.
Opperman, Ltd., S. E.
Smith's Stamping Works (Coventry), Ltd.
Wilmot Breeden, Ltd.

BOLTS.—see A.G.S. Parts

BONDING
Aero Research, Ltd.
Avionics, Ltd.
Goodyear Tyre and Rubber Co. (Great Britain), Ltd.
Silentbloc, Ltd.
Wellworthy, Ltd.
Whittemore (Aeradio), Ltd., A. J.

Ransome and Marles ball and roller bearing components.

BRAKES, AIRCRAFT, AND COMPONENTS
Aircraft Spares and Components
Avica Equipment, Ltd.
British Belting and Asbestos, Ltd.
Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Girling, Ltd.
Goodyear Tyre and Rubber Co. (Great Britain), Ltd.
Hadfields, Ltd.
Newton and Co., H. T.
Opperman, Ltd., S. E.
Palmer Tyre, Ltd., The
Walter, A. J.

BRASS
Aircraft Materials, Ltd.
Birkett, Billington and Newton, Ltd., T. M.
Booth and Co., Ltd., James
Imperial Chemical Industries, Ltd.
Sandwell Casting Co., The
Stone and Co. (Charlton), Ltd., J.
Wilson and Sons (London), Ltd., W.

BUILDINGS, AIRFIELD
Burgess and Co., Ltd., G. H.
Hawkesley S. M. D., Ltd.
Horseley Bridge and Thomas Piggott, Ltd.
Ross, Ltd., S. Grahame
Scottish Aviation, Ltd.
Whiting and Co., E. J.

CABLES, CONTROL, AND ACCESSORIES
Aircraft Materials, Ltd.
Aircraft Spares and Components
Bowden Engineers, Ltd.
Dundas, Ltd., R. K.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
King Aircraft Corporation
Newton and Co., H. T.
Rist's, Wires and Cables, Ltd.
Rollason, Ltd., W. A.
Teleflex Products, Ltd.

CABLES, ELECTRICAL
Aerocontacts (Sales), Ltd.
Aircraft Spares and Components
Avica Equipment, Ltd.
Avionics, Ltd.
British Insulated Callender's Cables, Ltd.
British Wire Products, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Lincoln Electric Co., Ltd.
Newton and Co., H. T.
Plessey Group
Rist's, Wires and Cables, Ltd.
Rotax, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Whittemore (Aeradio), Ltd., A. J.

CALIBRATION EQUIPMENT
A.J.W. (Instruments), Ltd.
Amal, Ltd.
Avery-Hardoll, Ltd.
Avionics, Ltd.
Decca Navigator Co., Ltd., The
Dundas, Ltd., R. K.
General Electric Co., Ltd., The
Graseby Instruments, Ltd.
Munro, Ltd., R. W.
Murphy Radio, Ltd.
Pullin and Co., Ltd., R. B.
Reilly Engineering, Ltd.
Rollason Aerocessories, Ltd.
Whittemore (Aeradio), Ltd.
Wilmot Breeden, Ltd.

CAMERAS, AERIAL
Newton and Co., H. T.
Stewart Aeronautical Supply Co., Ltd.
Vinten, Ltd., W.
Williamson Manufacturing Co., Ltd.

CAMERAS, RESEARCH
Avimo of Taunton
Brown, Ltd., S. G.
Kodak, Ltd.
Pullin and Co., Ltd., R. B.
Southern Instruments, Ltd.
Stewart Aeronautical Supply, Co., Ltd.
Vinten, Ltd., W.
Williamson Manufacturing Co., Ltd.

CANOPY ACTUATION AND JETTISON EQUIPMENT
Hymatic Engineering Co., Ltd., The
M.L. Aviation Co., Ltd.
Martin-Baker Aircraft Co., Ltd.
Opperman, Ltd., S. E.
Redwing, Ltd.
Rotax, Ltd.

CANOPIES, COCKPIT (see also Plastics)
Aero Maintenance Equipment, Ltd.
Essex Aero, Ltd.
Field Aircraft Services, Ltd.
Miles, Ltd., F. G.
Rollason, Ltd., W. A.
Suntex Safety Glass Industries, Ltd.
Thermo-Plastics, Ltd.
Triplex Safety Glass Co., Ltd., The

CAPACITORS
Aerocontacts (Sales), Ltd.
Avionics, Ltd.
British Thomson-Houston Co., Ltd., The
Dawe Instruments, Ltd.
Field Aircraft Services, Ltd.
Mullard, Ltd.
Newton and Co., H. T.
Plessey Group
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

CARAVANS
Eccles (Birmingham), Ltd.
Jablo Plastics Industries, Ltd.

CARBURETTORS
Aircraft Spares and Components
Air Engine Services (U.S.-U.K.), Ltd.
Field Aircraft Services, Ltd.
Hobson, Ltd., H. M.
Newton and Co., H. T.
Rollason Engines, Ltd.
Walter, A. J.

CASTINGS, LIGHT ALLOY
Birkett, Billington and Newton, Ltd., T. M.
Essex Aero, Ltd.
Glacier Metal Co., Ltd., The
High Duty Alloys, Ltd.
Mills, Ltd., William
Northern Aluminium Co., Ltd.
Renfrew Foundries, Ltd.
Revo Electric Co., Ltd.
Sandwell Casting Co., The
Sterling Metals, Ltd.
Stone and Co. (Charlton), Ltd., J.
Vosper, Ltd.
Wellworthy, Ltd.

CASTINGS, STEEL
Brown Foundries Co., The David
Firth and John Brown, Ltd., Thos.
Firth-Vickers Stainless Steels, Ltd.
Hadfields, Ltd.
Jessop and Sons, Ltd., William
Revo Electric Co., Ltd.

CASTINGS, OTHER THAN ABOVE
Birkett, Billington and Newton, Ltd., T. M.
Brown Foundries Co., The David
Revo Electric Co., Ltd.
Salter and Co., Ltd., Geo.
Sandwell Casting Co., The
Stone and Co. (Charlton), Ltd., J.
Vosper, Ltd.
Yorkshire Engineering Supplies, Ltd.

CHAIN, DRIVING
Renold Chains, Ltd.

CHEMICALS, INDUSTRIAL
Imperial Chemical Industries, Ltd.
Jenolite, Ltd.
Laporte Chemicals, Ltd.
Pyrene Co., Ltd., The
Valay Industries, Ltd.

CLEANING MATERIALS AND EQUIPMENT
Aeroservices, Ltd.
Aircraft Materials, Ltd.
Brent Chemical Products, Ltd.
Irano Products, Ltd.
Jenolite, Ltd.
New Welbeck, Ltd.
Pyrene Co., Ltd., The
Valay Industries, Ltd.

CLIPS
Aircraft Materials, Ltd.
Avica Equipment, Ltd.
Dunlop Rubber Co., Ltd.,
Hellermann, Ltd.
King Aircraft Corporation
Newton and Co., H. T.
Opperman, Ltd., S. E.
Ross, Ltd., S. Grahame
Salter and Co., Ltd., Geo.
Terry and Sons, Ltd., Herbert

CLOTHING, FLYING
Aerocontacts (Sales), Ltd.
Aero Maintenance Equipment, Ltd.
Anticoustic Co., The
Dundas, Ltd., R. K.
Elliot Equipment, Ltd.
Flint, Ltd., Howard
Frankenstein and Sons (Manchester), Ltd., P.
G.Q. Parachute Co., Ltd.
Gieves, Ltd.
Lewis, Ltd., D.
M.L. Aviation Co., Ltd.
Siebe, Gorman and Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.
Suchy Holdings Group

CLOTHING, UNIFORM
Aero Maintenance Equipment, Ltd.
Austin Reed
Chemring, Ltd.
Fishers'
Fothergill and Harvey (Sales), Ltd.
Gieves, Ltd.
Suchy Holdings Group

COMMUNICATIONS EQUIPMENT
Aerocontacts (Sales), Ltd.
Aeronautical Radio Services, Ltd.
Airwork General Trading Co.
Aviation Traders, Ltd.
Avionics, Ltd.
British Thomson-Houston Co., Ltd., The
Burndept, Ltd.
Chelton (Electrostatics), Ltd.
Cole, Ltd., E. K.
Decca Navigator Co., Ltd., The
E.R.S. (London), Ltd.
Eagle Aircraft Services, Ltd.
Easco Electrical (Holdings), Ltd.
Ekco Electronics, Ltd.
Elliott Brothers (London), Ltd.
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Field Aircraft Services, Ltd.
Fonadek (Branson), Ltd.
General Electric Co., Ltd., The

(Continued on p. 415)

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Marconi's Wireless Telegraph Co., Ltd.
Mullard, Ltd.
Murphy Radio, Ltd.
Newton and Co., H. T.
Plessey Group
Pye, Ltd.
Racal, Ltd.
Racal Engineering, Ltd.
Redifon, Ltd.
Rollason, Ltd., W. A.
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Thermionic Products, Ltd.
Thorn Electrical Industries, Ltd.
Whittemore (Aeradio), Ltd., A. J.
Z. and I. Aero Services, Ltd.

COMPONENTS, AIRFRAME (see also Assemblies, Major Airframe)

Aircraft Engineering and Jigs, Ltd.
Aircraft Spares and Components
Airflow Streamlines, Ltd.
Aviation Traders (Engineering), Ltd.
Avica Equipment, Ltd.
Bramah and Co., Ltd., J. B.
Brown, Ltd., S. G.
Burgess and Co., Ltd., G. H.
Burnley Aircraft Products, Ltd.
Chinn and Co., Ltd., J. S.
Corner and Co., Ltd., G.
Cornercroft, Ltd.
Dart Aircraft, Ltd.
Dundas, Ltd., R. K.
Eagle Aircraft Services, Ltd.
English Steel Corporation, Ltd.
Essex Aero, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Hadfields, Ltd.
Heston Aircraft Co., Ltd., The
Hunting Percival Aircraft, Ltd.
Jameson Aero Engines, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Miles, Ltd., F. G.
Newton and Co., H. T.
Opperman, Ltd., S. E.
Portsmouth Aviation, Ltd.
Redwing, Ltd.
Rollason, Ltd., W. A.
Samlesbury Engineering, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Tiltman Langley, Ltd.
Walter, A. J.
Welsh Metal Industries, Ltd.
Wilmot Breeden, Ltd.

COMPONENTS, GAS-TURBINE SHEET METAL

Airflow Streamlines, Ltd.
Aviation Traders (Engineering), Ltd.
Bramah and Co., Ltd., J. B.
Briggs Motor Bodies, Ltd.
Burnley Aircraft Products, Ltd.
Chinn and Co., Ltd., J. S.
Corner and Co., Ltd., G.
Cornercroft, Ltd.
Redwing, Ltd.
Samlesbury Engineering, Ltd.
Sankey and Sons, Ltd., Joseph
Thompson Bros. (Bilston), Ltd.
V.P. Sheet Metal, Ltd.
Wilmot Breeden, Ltd.

COMPRESSORS, INDUSTRIAL

Atlas Diesel Co., Ltd.
Hymatic Engineering Co., Ltd., The
Muir and Adie, Ltd.
Rollason Aerocessories, Ltd.
Rotax, Ltd.
Rover Gas Turbines, Ltd.
Siebe, Gorman and Co., Ltd.
Tecalemit, Ltd.

CONNECTORS, ELECTRICAL

Aerocontacts (Sales), Ltd.
Aeronautical Radio Services, Ltd.
Aircraft Materials, Ltd.
Avica Equipment, Ltd.
E.R.S., Ltd.
English Electric Co., Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Insulators, Ltd.
M.L. Aviation Co., Ltd.
Newton and Co., H. T.
Plessey Group
Rist's, Wires and Cables, Ltd.
Rotax, Ltd.
Smiths Aircraft Instruments, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Telegraph Construction and Maintenance Co., Ltd., The

CONNECTORS, HOSE

Aerocontacts (Sales), Ltd.
Aircraft Materials, Ltd.
Aircraft Spares and Components.
Avery-Hardoll, Ltd.
Avica Equipment, Ltd.
Avimo of Taunton
Bell's Asbestos and Engineering, Ltd.
Bowden Engineers, Ltd.
Exactors, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
High-Pressure Components, Ltd.
Newton and Co., H. T.
Plessey Group
Super Oil Seals and Gaskets, Ltd.

CONSULTANTS

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Air Engine Services (U.S.-U.K.), Ltd.
Aviation Traders (Engineering), Ltd.
Baynes Aircraft Interiors, Ltd.
Dundas, Ltd., R. K.
International Aeradio, Ltd.
Hunting Aerosurveys, Ltd.
Jameson Aero Engines, Ltd.
Mollart Engineering Co., Ltd., The
Mond Nickel Co., Ltd., The
Power Jets (Research and Development), Ltd.
Racal Aerotronics, Ltd.
Redwing, Ltd.
Rollason Aerocessories, Ltd.
Rollason, Ltd., W. A.
Sutton (Consultants), Ltd., R. W.
Tiltman Langley, Ltd.
Vernons Industries, Ltd.

CONTROLS, ENGINE

Aero Controls, Ltd.
Aircraft Spares and Components
Bloctube Controls, Ltd.
Dundas, Ltd., R. K.
Exactor, Ltd.
Field Aircraft Services, Ltd.
Hobson, Ltd., H. M.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Newton and Co., H. T.
Rollason Engines, Ltd.
Rotol, Ltd.
Teleflex Products, Ltd.
Ultra Electric, Ltd.
Walter, A. J.

CONTROLS, FLYING

Aero Controls, Ltd.
Aircraft Spares and Components
Automotive Products Co., Ltd.
Boulton Paul Aircraft, Ltd.
British Messier, Ltd.
Brown, Ltd., S. G.
Dowty Equipment, Ltd.
Dundas, Ltd., R. K.
Eagle Aircraft Services, Ltd.
Elliott Brothers (London), Ltd.
Field Aircraft Services, Ltd.
Girling, Ltd.
Hobson, Ltd., H. M.
Newton and Co., H. T.
Opperman, Ltd., S. E.
Rollason, Ltd., W. A.
Sperry Gyroscope Co., Ltd.
Teleflex Products, Ltd.
Ultra Electric, Ltd.
Walter, A. J.
Wilmot Breeden, Ltd.

COOLANTS

Field Aircraft Services, Ltd.

COOLERS, OIL

Aircraft Spares and Components
Delaney Gallay, Ltd.
Field Aircraft Services, Ltd.
Marston Excelsior, Ltd.
Newton and Co., H. T.
Rollason Engines, Ltd.
Serck Radiators, Ltd.
V.P. Sheet Metal, Ltd.
Walter, A. J.

COPPER

Aircraft Materials, Ltd.
Booth and Co., Ltd., James
British Insulated Callender's Cables, Ltd.
Imperial Chemical Industries, Ltd.
Kaye, Ltd., E. and E.
Stone and Co. (Charlton), Ltd., J.
Wilson and Sons (London), Ltd., W.

CORROSION INHIBITORS AND EQUIPMENT

Aeroservices, Ltd.
Brand and Co., Ltd., R. A.
Brent Chemical Products, Ltd.
Crane Packing, Ltd.
Essex Aero, Ltd.
Field Aircraft Services, Ltd.
Jenolite, Ltd.
Modern Industrial Finishes, Ltd.
Pyrene Co., Ltd., The
Shell-Mex and B.P., Ltd.
Skyhi, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Valay Industries, Ltd.
Wakefield and Co., Ltd., C. C.
Walterisation Co., Ltd., The

COUNTING EQUIPMENT

Counting Instruments, Ltd.
Standard Telephones and Cables, Ltd.

COUPLINGS, FLEXIBLE

Aerocontacts (Sales), Ltd.
Aircraft Spares and Components.
Avica Equipment, Ltd.
Bell's Asbestos and Engineering, Ltd.
Crane Packing, Ltd.
Dowty Equipment, Ltd.
Dunlop Rubber Co., Ltd.
Flight Refuelling, Ltd.
Hardy Spicer, Ltd.
I.V. Pressure Controllers, Ltd.
Mollart Engineering Co., Ltd., The
Newton and Co., H. T.
Rellumit (London), Ltd.
Renold Chains, Ltd.
Silentbloc, Ltd.
Stewart Aeronautical Supply Co., Ltd.

DECARBONIZING PREPARATIONS AND EQUIPMENT

Aeroservices, Ltd.
Bennett (Hyde), Ltd.
Brent Chemical Products, Ltd.
Modern Industrial Finishes, Ltd.

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DEGREASING EQUIPMENT

Aerocontacts (Sales), Ltd.
Aeroservices, Ltd.
Aircraft Materials, Ltd.
Bennett (Hyde), Ltd.
Brent Chemical Products, Ltd.
Imperial Chemical Industries, Ltd.
Irano Products, Ltd.
Jenolite, Ltd.
Newton and Co., H. T.
Pyrene Co., Ltd., The
Valay Industries, Ltd.
Walterisation Co., Ltd., The

DE-ICING AND ANTI-ICING EQUIPMENT AND FLUIDS, ETC.

Aerocontacts (Sales), Ltd.
Avica Equipment, Ltd.
Bell's Asbestos and Engineering, Ltd.
Delaney Gallay, Ltd.
Dragonair, Ltd.
Dunlop Rubber Co., Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Kenilworth Manufacturing Co., Ltd., The
Kilfrost, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Napier and Son, Ltd., D.
Newton and Co., H. T.
Plessey Group
Rollason Aerocessories, Ltd.
Rotax, Ltd.
Rotol, Ltd.
Self-Priming Pump and Engineering Co., Ltd.
Shell-Mex and B.P., Ltd.
T.K.S. (Aircraft De-icing), Ltd.
Technograph Printed Circuits, Ltd.
Triplex Safety Glass Co., Ltd., The
Walter, A. J.
Zwicky, Ltd.

DESIGN WORK

Aero Controls, Ltd.
Aeronautical Radio Services, Ltd.
Aviation Traders (Engineering), Ltd.
Baynes Aircraft Interiors, Ltd.
British Emulsifiers, Ltd.
Burgess and Co., Ltd., G. H.
Burndept, Ltd.
Delaney Gallay, Ltd.
Dowty Equipment, Ltd.
Eagle Aircraft Services, Ltd.
Ferranti, Ltd.
Flight Refuelling, Ltd.
Hadley Co., Ltd., The
Helliwells, Ltd.
Heston Aircraft Co., Ltd., The
International Aeradio, Ltd.
King Aircraft Corporation
Leytonstone Jig and Tool Co., Ltd.
M. L. Aviation Co., Ltd.
Measuring Instruments (Pullin), Ltd.
Miles, Ltd., F. G.
Portsmouth Aviation, Ltd.
Power Jets (Research and Development), Ltd.
Pullin and Co., Ltd., R. B.
Redwing, Ltd.
Rollason Aerocessories, Ltd.
Rumbold and Co., Ltd., L. A.
Samlesbury Engineering, Ltd.
Saunders-Roe, Ltd.
Skyways, Ltd.
Thermo-Plastics, Ltd.
Tiltman Langley, Ltd.
Vernons Industries, Ltd.
Westminster Airways Servicing, Ltd.

DIALS, INSTRUMENT

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Amal, Ltd.
Dent and Co. and Johnson, Ltd.
Kelvin and Hughes (Aviation), Ltd.
London Name Plate Manufacturing Co., Ltd.
Pullin and Co., Ltd., R. B.
Smiths Aircraft Instruments, Ltd.
Thermo-Plastics, Ltd.
Wynnstruments, Ltd.

DIAPHRAGMS

Bell's Asbestos and Engineering, Ltd.
Crane Packing, Ltd.
Fireproof Tanks, Ltd.
Mechanism, Ltd.
Munro, Ltd., R. W.
Negretti and Zambra, Ltd.
Precision Rubbers, Ltd.

DOORS, FOLDING AND SLIDING

Bolton Gate Co., Ltd.
Heavian, Ltd.

DOPES.—see Finishes

DRAWING OFFICE EQUIPMENT

Blundell Rules, Ltd.
Mollart Engineering Co., Ltd., The

DRAWING OFFICE SERVICES

Dent and Co. and Johnson, Ltd.
Flight Refuelling, Ltd.
Helliwells, Ltd.
Heston Aircraft Co., Ltd., The
Leytonstone Jig and Tool Co., Ltd.
Portsmouth Aviation, Ltd.
Rollason Aerocessories, Ltd.
Thompson (Engineers), Ltd., Raymond F.
Tiltman Langley, Ltd.

EAR DEFENDERS

Anticoustic Co., The
Mallock-Armstrong Co., The
Siebe, Gorman and Co., Ltd.

EDUCATION, TECHNICAL

College of Aeronautical and Automobile Engineering, The
Eagle Aircraft Services, Ltd.
Power Jets (Research and Development), Ltd.
Saunders-Roe, Ltd.

ELECTRICAL EQUIPMENT, GENERAL

Aerocontacts (Sales), Ltd.
Aircraft Materials, Ltd.
Aircraft Spares and Components
Aviation Traders, Ltd.
Belling and Lee, Ltd.
British Thomson-Houston Co., Ltd., The
Crane Packing, Ltd.
Dundas, Ltd., R. K.
E. R. S. (London), Ltd.
Eagle Aircraft Services, Ltd.
Easipower, Ltd.
Eastern Aero Electrical Services, Ltd.

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Electrical Equipment, General (Continued)

Elliott Brothers (London), Ltd.
English Electric Co., Ltd.
Ferranti, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
M. L. Aviation Co., Ltd.
McMichael Radio, Ltd.
Measuring Instruments (Pullin), Ltd.
Newton and Co., H. T.
Newton Brothers (Derby), Ltd.
Plessey Group
Pullin and Co., Ltd., R. B.
Revo Electric Co., Ltd.
Rist's Wires and Cables, Ltd.
Rollason, Ltd., W. A.
Salford Electrical Instruments, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Stone and Co. (Deptford), Ltd., J.
Suchy Holdings Group
Telegraph Construction and Maintenance Co., Ltd., The
Thorn Electrical Industries, Ltd.
Vernons Industries, Ltd.
Waymouth Gauges and Instruments, Ltd.
Wynn and Co. (Aircraft), Ltd., E. D.

ELECTRONIC EQUIPMENT, GENERAL

A. J. W. (Instruments), Ltd.
Aerocontacts (Sales), Ltd.
Aeronautical Radio Services, Ltd.
Aircraft Spares and Components
Air Trainers, Ltd.
Anticoustic Co., The
Automatic Coil Winder and Electrical Equipment Co., Ltd.
Avimo of Taunton
Avionics, Ltd.
Belling and Lee, Ltd.
Boulton Paul Aircraft, Ltd.
British Communications Corporation, Ltd.
British Thomson-Houston Co., Ltd., The
Burndept, Ltd.
Cole, Ltd., E. K.
Crane Packing, Ltd.
Dawe Instruments, Ltd.
Decca Radar, Ltd.
E.R.S. (London), Ltd.
Ekco Electronics, Ltd.
Elliott Brothers (London), Ltd.
English Electric Co., Ltd.
Ferranti, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Goodmans Industries, Ltd.
International Aeradio, Ltd.
Lancefield Aircraft Components, Ltd.
M. L. Aviation Co., Ltd.
McMichael Radio, Ltd.
Measuring Instruments (Pullin), Ltd.
Mullard, Ltd.
Murphy Radio, Ltd.
Newton and Co., H. T.
Opperman, Ltd., S. E.
Plessey Group
Pullin and Co., Ltd., R. B.
Pye, Ltd.
Racal, Ltd.
Racal Engineering, Ltd.
Revo Electric Co., Ltd.
Rollason Aerocessories, Ltd.
Salford Electrical Instruments, Ltd.
Sanders (Electronics), Ltd., W. H.
Saunders-Roe, Ltd.
Short Brothers and Harland, Ltd.
Southern Instruments, Ltd.
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Thorn Electrical Industries, Ltd.
Wayne Kerr Laboratories, Ltd., The
Whittemore (Aeradio), Ltd., A. J.
Wynnstruments, Ltd.
Z. and I. Aero Services, Ltd.

ENGINE COMPONENTS, GENERAL (piston engines)

Aerocontacts (Sales), Ltd.
Aeroservices, Ltd.
Air Engine Services (U.S.-U.K.), Ltd.
Amal, Ltd.
Aviation Traders, Ltd.
Birkett, Billington and Newton, Ltd., T. M.
Cross Manufacturing Co. (1938), Ltd.
Dart Aircraft, Ltd.
de Havilland Engine Co., Ltd., The
Dundas, Ltd., R. K.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Jameson Aero Engines, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Muir and Adie, Ltd.
Newton and Co., H. T.
Omes, Ltd.
Reynolds Tube Co., Ltd.
Rollason Engines, Ltd.
Samlesbury Engineering, Ltd.
Shackleton, Ltd., W. S.
V. P. Sheet Metal, Ltd.
Walter, A. J.
Weyburn Engineering Co., Ltd.

ENGINE COMPONENTS, GENERAL (gas turbines)

Birkett, Billington and Newton, Ltd., T. M.
Cross Manufacturing Co. (1938), Ltd.
Dart Aircraft, Ltd.
de Havilland Engine Co., Ltd., The
English Steel Corporation, Ltd.
Hadfields, Ltd.
Jameson Aero Engines, Ltd.
King Aircraft Corporation
Leytonstone Jig and Tool Co., Ltd.
Newton and Co., H. T.
Opperman, Ltd., S. E.
Reynolds Tube Co., Ltd.
Sankey and Sons, Ltd., Joseph
V. P. Sheet Metal, Ltd.
Waymouth Gauges and Instruments, Ltd.
Weyburn Engineering Co., Ltd.
Wilmot Breeden, Ltd.

ENGINE STARTING EQUIPMENT (see also Ground Power Units)

Aerocontacts (Sales), Ltd.
Aeroservices, Ltd.
Aero Maintenance Equipment, Ltd.
British Thomson-Houston Co., Ltd., The
City Electrical Co.
Eagle Aircraft Services, Ltd.
Hymatic Engineering Co., Ltd., The
I. V. Pressure Controllers, Ltd.
Lacy-Hulbert and Co., Ltd.
Newton and Co., H. T.
Partridge, Wilson and Co., Ltd.
Plessey Group
Rover Gas Turbines, Ltd.
Salford Electrical Instruments, Ltd.
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Teddington Aircraft Controls, Ltd.
Vernons Industries, Ltd.
Westinghouse Brake and Signal Co., Ltd.

EXPERIMENTAL WORK

Aero Controls, Ltd.
Air Trainers, Ltd.
Airwork General Trading Co.
Aviation Traders (Engineering), Ltd.
British Communications Corporation, Ltd.
British Messier, Ltd.
British Thomson-Houston Co., Ltd., The
Brown, Ltd., S. G.
Burndept, Ltd.
Burnley Aircraft Products, Ltd.
Chinn and Co., Ltd., J. S.
Corner and Co., Ltd., G.
Cornercroft, Ltd.
Cross Manufacturing Co. (1938), Ltd.
Dart Aircraft, Ltd.
Dent and Co. and Johnson, Ltd.
Eagle Aircraft Services, Ltd.
Essex Aero, Ltd.
Fairey Aviation Co., Ltd., The
Flight Refuelling, Ltd.
Graseby Instruments, Ltd.
Grawiner Manufacturing Co., Ltd.
Hadley Co., Ltd., The
Henderson Safety Tank Co., Ltd., The
Heston Aircraft Co., Ltd., The
I. V. Pressure Controllers, Ltd.
International Aeradio, Ltd.
Jameson Aero Engines, Ltd.
Leytonstone Jig and Tool Co., Ltd.
M. L. Aviation Co., Ltd.
Miles, Ltd., F. G.
Modern Industrial Finishes, Ltd.
Mollart Engineering Co., Ltd., The
Mullard, Ltd.
Opperman, Ltd., S. E.
Palmer Tyre, Ltd., The
Portsmouth Aviation, Ltd.
Pullin and Co., Ltd., R. B.
R.F.D. Co., Ltd.
Redwing, Ltd.
Reilly Engineering, Ltd.
Rollason Aerocessories, Ltd.
Rubery, Owen and Co., Ltd.
Rumbold and Co., Ltd., L. A.
Salford Electrical Instruments, Ltd.
Saunders-Roe, Ltd.
Scottish Aviation, Ltd.
Siebe, Gorman and Co., Ltd.
Thermo-Plastics, Ltd.
Tiltman Langley, Ltd.
Ultra Electric, Ltd.
V. P. Sheet Metal, Ltd.
Vernons Industries, Ltd.
Westminster Airways Servicing, Ltd.
Wilmot Breeden, Ltd.
Wynnstruments, Ltd.

EXTRUSIONS, LIGHT ALLOY

Birmetals, Ltd.
Booth and Co., Ltd., James
Essex Aero, Ltd.
Garringtons, Ltd.
High Duty Alloys, Ltd.
Imperial Chemical Industries, Ltd.
Kaye, Ltd., E. and E.
Northern Aluminium Co., Ltd.
Southern Forge, Ltd.
Wilson and Sons (London), Ltd., W.

EXTRUSIONS, STEEL

Chesterfield Tube Co., Ltd., The
Low Moor Fine Steels, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph

FABRICATIONS, SHEET METAL

Aircraft Engineering and Jigs, Ltd.
Airflow Streamlines, Ltd.
Aviation Traders (Engineering), Ltd.
Avionics, Ltd.
Bramah and Co., Ltd., J. R.
Briggs Motor Bodies, Ltd.
British Emulsifiers, Ltd.
Brown and Co., Ltd., E. G.
Burgess and Co., Ltd., G. H.
Burndept, Ltd.
Burnley Aircraft Products, Ltd.
Chemring, Ltd.
Chinn and Co., Ltd., J. S.
Corner and Co., Ltd., G.
Cornercroft, Ltd.
Dart Aircraft, Ltd.
Delaney Gallay, Ltd.
Equator Wheels and Sections, Ltd.
Easipower, Ltd.
Essex Aero, Ltd.
Helliwells, Ltd.
Henderson Safety Tank Co., Ltd., The
Heston Aircraft Co., Ltd., The
Jablo Plastics Industries, Ltd.
King Aircraft Corporation
Lancefield Aircraft Components, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Marston Excelsior, Ltd.
Miles, Ltd., F. G.
Opperman, Ltd., S. E.
Portsmouth Aviation, Ltd.
Rollason Aerocessories, Ltd.
Rubery, Owen and Co., Ltd.
Rumbold and Co., Ltd., L. A.
Samlesbury Engineering, Ltd.
Sankey and Sons, Ltd., Joseph
Thompson Bros (Bilston), Ltd.
Tiltman Langley, Ltd.
V.P. Sheet Metal, Ltd.
Vernons Industries, Ltd.
Vosper, Ltd.
Welsh Metal Industries, Ltd.
Westminster Airways Servicing, Ltd.
Wilmot Breeden, Ltd.
Whittemore (Aeradio), Ltd., A. J.

FABRICATIONS, TUBULAR

Aero Maintenance Equipment, Ltd.
Aircraft Engineering and Jigs, Ltd.
Aviation Traders (Engineering), Ltd.
Bramah and Co., Ltd., J. R.
British Emulsifiers, Ltd.
Burgess and Co., Ltd., G. H.
Chinn and Co., Ltd., J. S.
Dart Aircraft, Ltd.
Essex Aero, Ltd.
Helliwells, Ltd.
Heston Aircraft Co., Ltd., The
King Aircraft Corporation
Lancefield Aircraft Components, Ltd.
Miles, Ltd., F. G.
Reynolds Tube Co., Ltd.
Rollason Aerocessories, Ltd.
Rumbold and Co., Ltd., L. A.
Tiltman Langley, Ltd.
V. P. Sheet Metal, Ltd.
Westminster Airways Servicing, Ltd.

FABRIC, AIRFRAME

Aerocontacts (Sales), Ltd.
Aircraft Materials, Ltd.
Cox and Son, Ltd., John
Field Aircraft Services, Ltd.
Newton and Co., H. T.
Rollason, Ltd., W. A.
Vane and Co., A. H.

FABRIC, CABIN FURNISHING

Aerocontacts (Sales), Ltd.
B. X. Plastics, Ltd.
Baynes Aircraft Interiors, Ltd.
Bell's Asbestos and Engineering, Ltd.
Cox and Son, Ltd., John
Field Aircraft Services, Ltd.
Fothergill and Harvey (Sales), Ltd.
Rollason, Ltd., W. A.
Rumbold and Co., Ltd., L. A.

FANS

Airscrew Co. and Jicwood, Ltd., The
Aviation Traders (Engineering), Ltd.
English Electric Co., Ltd.
General Electric Co., Ltd., The
Revo Electric Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.

FASTENERS, COWLING AND SPECIAL PURPOSE

Aerocontacts (Sales), Ltd.
Aero Controls, Ltd.
Amal, Ltd.
Baynes Aircraft Interiors, Ltd.
Dundas, Ltd., R. K.
Dzus Fastener, Europe, Ltd.
Fairey Aviation Co., Ltd., The
Field Aircraft Services, Ltd.
King Aircraft Corporation
M. L. Aviation Co., Ltd.
Newton and Co., H. T.
Oddie, Bradbury and Cull, Ltd.
Rollason, Ltd., W. A.
Salter and Co., Ltd., Geo.
Simmonds Aerocessories, Ltd.
Stone and Co. (Deptford), Ltd., J.

FERROUS ALLOYS

Aircraft Materials, Ltd.
Balfour and Co., Ltd., Arthur
Carlisle and Co., Ltd., C. G.
Firth and John Brown, Ltd., Thos.
Firth-Vickers Stainless Steels, Ltd.
Fox and Co., Ltd., Samuel
Hadfields, Ltd.
Hall and Pickles, Ltd.
Headland, Ltd., Thos. P.
Jessop and Sons, Ltd., William
Kayser, Ellison and Co., Ltd.
Low Moor Alloy Steelworks, Ltd.
Low Moor Fine Steels, Ltd.
Standard Telephones and Cables, Ltd.

FILTERS

Aircraft Materials, Ltd.
Amal, Ltd.
Auto-Klean Strainers, Ltd.
Automotive Products Co., Ltd.
Avionics, Ltd.
Bramah and Co., Ltd., J. R.
Dunlop Rubber Co., Ltd.
Fibreglass, Ltd.
Glacier Metal Co., Ltd., The
Hale Hamilton and Co., Ltd.
Lacy-Hulbert and Co., Ltd.
King Aircraft Corporation
Mullard, Ltd.
Newton and Co., H. T.
Rellumit (London), Ltd.
Self-Priming Pump and Engineering Co., Ltd.
Simmonds Aerocessories, Ltd.
Streamline Filters, Ltd.
Tecalemit, Ltd.
Thompson Bros (Bilston), Ltd.
Vokes, Ltd.
Walter, A. J.
Whittemore (Aeradio), Ltd., A. J.
Zwicky, Ltd.

FINISHES, AIRCRAFT (see also Paints)

Aerocontacts (Sales), Ltd.
Antifyre, Ltd.
Cellon, Ltd.
Docker Brothers
Hall and Sons (Bristol and London), Ltd., John
Imperial Chemical Industries, Ltd.
Modern Industrial Finishes, Ltd.
Newton and Co., H. T.
Rollason, Ltd., W. A.
Ryland, Ltd., Llewellyn
Shackleton, Ltd., W. S.
Titanine, Ltd.

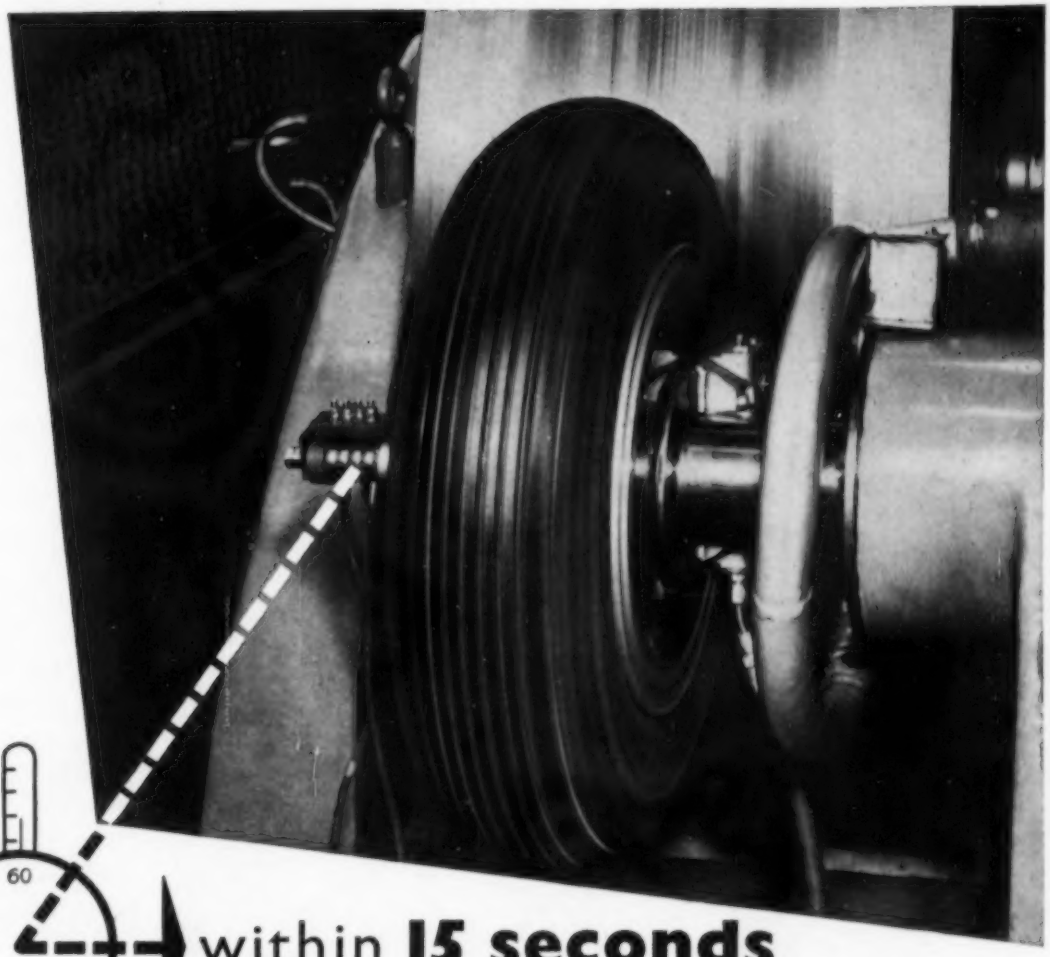
FIRE FIGHTING AND DETECTION EQUIPMENT, AIRBORNE

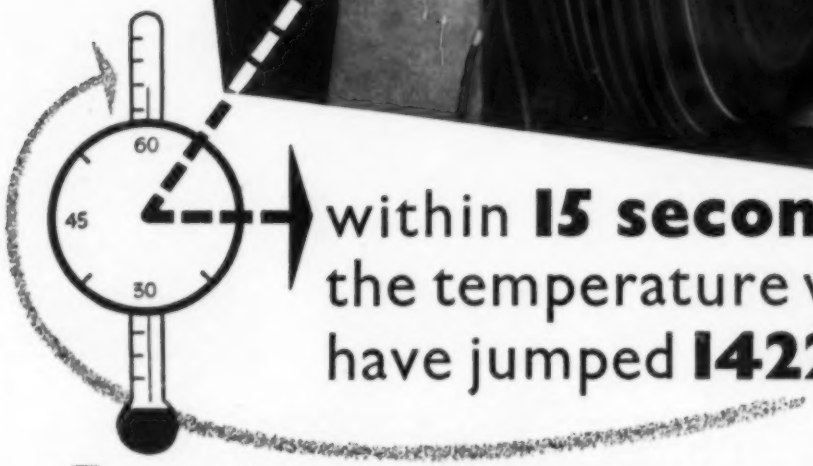
Aerocontacts (Sales), Ltd.
Antifyre, Ltd.
Dundas, Ltd., R. K.
Field Aircraft Services, Ltd.
Grawiner Manufacturing Co., Ltd.
Kidde Co., Ltd., The Walter
Newton and Co., H. T.
Pyrene Co., Ltd., The
Sangamo Weston, Ltd.
Scottish Aviation, Ltd.
Thermal Control Co., Ltd.

FIRE FIGHTING EQUIPMENT, GROUND

Aerocontacts (Sales), Ltd.
Antifyre, Ltd.
Bell's Asbestos and Engineering, Ltd.
Dundas, Ltd., R. K.

(Continued on p. 417)





within **15 seconds** the temperature will have jumped **1422°F**

IN 15 SECONDS the aeroplane wheel in this wheel-and-brake-dynamometer test will be brought to a stop — and in that brief space of time, *temperatures within the brake mechanism* will have jumped *1422°F!*

Now bear in mind that in such laboratory tests no slip stream cools the brake, making the test doubly tough on the friction pair — the spot linings and disc of the Goodyear Disc-Type Aircraft Brake.

This test is typical of those constantly carried out by Goodyear at Wallasey — typical of the continuing research that has made Goodyear the world-leader in brakes, wheels, tubes and tyres for the aircraft industry. This is also one of the primary reasons why development engineers come to Goodyear for assistance in designing the right brake while the plane is still on the drawing board. That's because they know the key to amazing performance and capacity-per-pound of Goodyear Wheels and Brakes is — in a large measure — the relentless testing, both in field and laboratory which has preceded Goodyear advances.

The resulting success is proved by the fact that more aircraft the world over land on Goodyear tyres, tubes, wheels and brakes than on any other kind.

GOODYEAR AVIATION PRODUCTS

WHEELS **BRAKES**

THE GOODYEAR TYRE & RUBBER CO. (G.B.) LTD. AVIATION DIVISION, WOLVERHAMPTON & WALLASEY

HUNTING PERCIVAL AIRCRAFT LTD.
GLOSTER AIRCRAFT CO. LTD.
BLACKBURN & GENERAL AIRCRAFT LTD.
THE BRISTOL AEROPLANE CO. LTD.
THE DE HAVILLAND AIRCRAFT CO. LTD.
THE ENGLISH ELECTRIC CO. LTD.
SHORT BROS. & HARLAND LTD.

leading constructors rely on

F-R

for approved

PRESSURE REFUELLING EQUIPMENT

SAUNDERS ROE LTD.
THE FAIREY AVIATION CO. LTD.
VICKERS-ARMSTRONGS LTD.
HAWKER AIRCRAFT LTD.
WESTLAND AIRCRAFT LTD.
HANDLEY PAGE LIMITED
AVRO AIRCRAFT LTD.
S.N.C.A.S.O.
S.N.C.A.S.E.
A. V. ROE & CO. LTD.

F-R Non-Return Valve

Lightest valve of its type (1.23 oz. for 1 in. size). Simple to install, needs no servicing. Perfect sealing characteristics. Low pressure loss. Sizes up to 3 in.

F-R Float Switch

Controls actuators or pumps without relays. Complies with latest vibration specifications. Fits through 2 in. aperture.

Aircraft Adapter

Designed for use with any coupling which meets international specifications. Simple, robust lightweight. Gives low pressure loss.

F-R In-Line Refuelling Valve

Can be placed well away from tanks; provides remote control (e.g. for refuelling drop tanks) and accessibility for servicing. Designed for simple maintenance.

VISIT US ON STAND NO. 161 AT FARNBOROUGH

PRESSURE REFUELLING F-R EQUIPMENT

FLIGHT REFUELLING LIMITED

Tarrant Rushton Airfield Blandford, Dorset, England. Telephone. Blandford 501. Telegrams: Refuelling, Blandford

THE ANCILLARY INDUSTRY . . .

Fire Fighting Equipment, Ground (Continued)

General Fire Appliance Co., Ltd.
High-Pressure Components, Ltd.
International Aeradio, Ltd.
Pyrene Co., Ltd., The
Rover Gas Turbines, Ltd.
Siebe, Gorman and Co., Ltd.
Turner Brothers Asbestos Co., Ltd.

FLAME TRAPS

Amal, Ltd.
Avimo of Taunton

FLOTATION GEAR

Elliot Equipment, Ltd.
Field Aircraft Services, Ltd.
Fireproof Tanks, Ltd.
Jablo Plastics Industries, Ltd.
Rellumit (London), Ltd.
R.F.D. Co., Ltd.
Ross, Ltd., S. Grahame

FLUID, HYDRAULIC

Aerocontacts (Sales), Ltd.
Automotive Products Co., Ltd.
Esso Petroleum Co., Ltd.
Field Aircraft Services, Ltd.
Kenilworth Manufacturing Co., Ltd., The
Regent Oil Co., Ltd.
Shell-Mex and B.P., Ltd.
Vacuum Oil Co., Ltd.
Wakefield and Co., Ltd., C. C.

FORGINGS, LIGHT ALLOY

Booth and Co., Ltd., James
Garringtons, Ltd.
High Duty Alloys, Ltd.
Northern Aluminium Co., Ltd.
Omes, Ltd.
Southern Forge, Ltd.

FORGINGS, STEEL

Balfour and Co., Ltd., Arthur
English Steel Corporation, Ltd.
Firth and John Brown, Ltd., Thos.
Firth-Derihon Stampings, Ltd., The
Firth-Vickers Stainless Steels, Ltd.
Garringtons, Ltd.
Hadfields, Ltd.
Jessop and Sons, Ltd., William
Kayser, Ellison and Co., Ltd.
Omes, Ltd.
Smith-Clayton Forge, Ltd.
Smith's Stamping Works (Coventry), Ltd.
Tubes, Ltd.

FORGINGS, OTHER THAN ABOVE

Firth-Derihon Stampings, Ltd., The
Garringtons, Ltd.
Omes, Ltd.
Vosper, Ltd.
Wiggin and Co., Ltd., Henry

FUELS, AIRCRAFT

B.P. Aviation Service
Esso Petroleum Co., Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Regent Oil Co., Ltd.
Shell-Mex and B.P., Ltd.

FUELS, ROCKET, ETC.

British Oxygen Co., Ltd., The
Flight Refuelling, Ltd.
Laporte Chemicals, Ltd.
Regent Oil Co., Ltd.

FUELLING EQUIPMENT

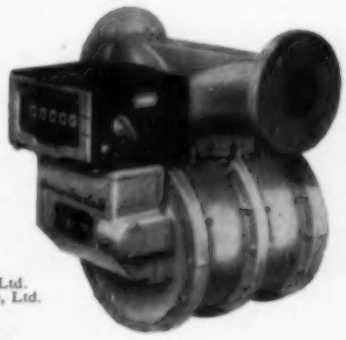
Aerocontacts (Sales), Ltd.
Avery-Hardoll, Ltd.
Crane Packing, Ltd.
Dundas, Ltd., R. K.
Elliott Brothers (London), Ltd.
Exactor, Ltd.
Flight Refuelling, Ltd.
King Aircraft Corporation
Mollart Engineering Co., Ltd., The
Rellumit (London), Ltd.
Rollason, Ltd., W. A.
Rotol, Ltd.
Saunders-Roe, Ltd.
Saunders Valve Co., Ltd.
Thompson Bros. (Bilston), Ltd.
Wayne Tank and Pump Co., Ltd.
Zwicky, Ltd.

FUEL SYSTEMS, ENGINE

Avica Equipment, Ltd.
Crane Packing, Ltd.
Dowty Fuel Systems, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Plessey Group
Rollason Engines, Ltd.
Rotol, Ltd.
Saunders Valve Co., Ltd.
Smiths Aircraft Instruments, Ltd.
Walter, A. J.

FURNISHING EQUIPMENT, AIRCRAFT

Aerocontacts (Sales), Ltd.
Baynes Aircraft Interiors, Ltd.
Chemring, Ltd.
Dart Aircraft, Ltd.
Dunlop Special Products, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd.
Hairlok Co., Ltd., The
Jablo Plastics Industries, Ltd.
Lancefield Aircraft Components, Ltd.
Latex Upholstery, Ltd.
Miles, Ltd., F. G.
Portsmouth Aviation, Ltd.
Rollason, Ltd., W. A.
Rumbold and Co., Ltd., L. A.
Scottish Aviation, Ltd.
Vickers-Armstrongs, Ltd.
Xetal Products, Ltd.



Avery-Hardoll Series PM bulkmeter, for test rigs and tank calibration.

FREIGHT HANDLING EQUIPMENT, AIRPORT

Access Equipment, Ltd.
Aerocontacts (Sales) Ltd.
Aero Maintenance Equipment, Ltd.
Aviation Traders (Engineering), Ltd.
Eccles (Birmingham), Ltd.
Partridge, Wilson and Co., Ltd.
Ross, Ltd., S. Grahame
Wilmot Breeden, Ltd.

FREIGHT EQUIPMENT, AIRBORNE

Aero Maintenance Equipment, Ltd.
Aviation Traders (Engineering), Ltd.
Baynes Aircraft Interiors, Ltd.
Rollason Aerocessories, Ltd.
Scottish Aviation, Ltd.

FRICTION LININGS

British Belting and Asbestos, Ltd.
Goodyear Tyre and Rubber Co. (Great Britain), Ltd.

FUSES

Aerocontacts (Sales), Ltd.
Aviation Traders, Ltd.
Avionics, Ltd.
Field Aircraft Services, Ltd.
Newton and Co., H. T.
Stewart Aeronautical Supply Co., Ltd.
Suchy Holdings Group
Walter, A. J.
Whittemore (Aeradio), Ltd., A. J.
Wynn and Co. (Aircraft), Ltd., E. D.

GALLEY EQUIPMENT

Attewell and Sons, Ltd., B.
Baynes Aircraft Interiors, Ltd.
Dart Aircraft, Ltd.
General Electric Co., Ltd., The
Jablo Plastics Industries, Ltd.
Redwing, Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame
Rumbold and Co., Ltd., L. A.
Saunders Valve Co., Ltd.
Scottish Aviation, Ltd.

GASKETS.—see Jointing Materials

GEARS AND GEAR SYSTEMS

British Thomson-Houston Co., Ltd., The
Brown Gears (London), Ltd., David
Brown, Ltd., S. G.
Campbell (Engineers), Ltd., J. R.
Dent and Co. and Johnson, Ltd.
E. N. V. Engineering Co., Ltd.
Gear Grinding Co., Ltd., The
Graseby Instruments, Ltd.
Mollart Engineering Co., Ltd., The
Newton and Co., H. T.
Opperman, Ltd., S. E.
Pullin and Co., Ltd., R. B.
Rotax, Ltd.
Tiltman Langley, Ltd.
Tufnol, Ltd.
Wilmot Breeden, Ltd.

GENERATORS, ELECTRIC

Aerocontacts (Sales), Ltd.
Aeroservices, Ltd.
Avionics, Ltd.
British Thomson-Houston Co., Ltd., The
Dundas, Ltd., R. K.
Eagle Aircraft Services, Ltd.
Eastern Aero Electrical Services, Ltd.
English Electric Co., Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Lincoln Electric Co., Ltd.
Newton and Co., H. T.
Newton Bros. (Derby), Ltd.
Plessey Group
Rotax, Ltd.
Rotol, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Vernons Industries, Ltd.
Walter, A. J.
Whittemore (Aeradio), Ltd., A. J.
Wynn and Co. (Aircraft), Ltd., E. D.

GLASS, SAFETY

Suntex Safety Glass Industries, Ltd.
Triplex Safety Glass Co., Ltd., The

GRINDING EQUIPMENT (see also Tools, Machine)

Aeroservices, Ltd.
Atlas Diesel Co., Ltd.
Black and Decker, Ltd.
Flexible Drives (Gilmans), Ltd.
Morris, Ltd., B. O.
Reilly Engineering, Ltd.
Van Moppes and Sons (Diamond Tools), Ltd., L. M.
Wilmot Breeden, Ltd.

GROUND POWER UNITS.—see Starters

GUNS.—see Armament

GYRO INSTRUMENTS

Aerocontacts (Sales), Ltd.
Avimo of Taunton
Brown, Ltd., S. G.
Dundas, Ltd., R. K.
Elliott Brothers (London), Ltd.
E.M.O. Instrumentation, Ltd.
Ferranti, Ltd.
Field Aircraft Services, Ltd.
Graseby Instruments, Ltd.
Kelvin and Hughes (Aviation), Ltd.
Muir and Adie, Ltd.
Newmark, Ltd., Louis
Newton and Co., H. T.
Pullin and Co., Ltd., R. B.
Reid and Sigrist, Ltd.
Smiths Aircraft Instruments, Ltd.
Speke Instrument Co.
Sperry Gyroscope Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.
Wynn and Co. (Aircraft), Ltd., E. D.

HANGARS

Aerocontacts (Sales), Ltd.
Bellman Hangars, Ltd.
British Insulated Callender's Cables, Ltd.
Dundas, Ltd., R. K.
Hawksley S. M. D., Ltd.
Horseley Bridge and Thomas Piggott, Ltd.
Whiting and Co., E. J.

HANGARAGE

Flight Refuelling, Ltd.
Rollason, Ltd., W. A.

HARNESSES, AIRCREW

Aerocontacts (Sales), Ltd.
Baynes Aircraft Interiors, Ltd.
Chemring, Ltd.
Field Aircraft Services, Ltd.
G. Q. Parachute Co., Ltd.
Newton and Co., H. T.
Rollason, Ltd., W. A.
Rumbold and Co., Ltd., L. A.
Siebe, Gorman and Co., Ltd.

HEATERS, AIRCRAFT

British Thomson-Houston Co., Ltd., The
Chemring, Ltd.
Delaney Gallay, Ltd.
Dragonair, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Lucas (Gas Turbine Equipment), Ltd., Joseph
Marston Excelsior, Ltd.
Technograph Printed Circuits, Ltd.

HEATERS, HANGAR AND FACTORY

Dragonair, Ltd.
General Electric Co., Ltd., The
Rover Gas Turbines, Ltd.

HEAT-EXCHANGERS

Burnley Aircraft Products, Ltd.
Delaney Gallay, Ltd.
Dragonair, Ltd.
Ferranti, Ltd.
Field Aircraft Services, Ltd.
Marston Excelsior, Ltd.
Sankey and Sons, Ltd., Joseph
Serck Radiators, Ltd.
Walter, A. J.

HEAT-RESISTANT ALLOYS

Firth-Vickers Stainless Steels, Ltd.
Fox and Co., Ltd., Samuel
Hadfields, Ltd.
Hall and Pickles, Ltd.
Jessop and Sons, Ltd., William
Kayser, Ellison and Co., Ltd.
Mond Nickel Co., Ltd., The
Stone and Co. (Charlton), Ltd., J.
Wiggin and Co., Ltd., Henry

HEATING EQUIPMENT, INDUSTRIAL PROCESS

British Thomson-Houston Co., Ltd., The
Standard Telephones and Cables, Ltd.

HOSE, FLEXIBLE

Aerocontacts (Sales), Ltd.
Aircraft Materials, Ltd.
Atlas Diesel Co., Ltd.
Automotive Products Co., Ltd.
Avery-Hardoll, Ltd.
Avica Equipment, Ltd.
B.X. Plastics, Ltd.
Bell's Asbestos and Engineering, Ltd.
Bowden Engineers, Ltd.
Dundas, Ltd., R. K.
Dunlop Rubber Co., Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Goodyear Tyre and Rubber Co. (Great Britain), Ltd., The
Hall and Hall, Ltd.
Heinke and Co., Ltd., C. E.
Hellermann, Ltd.
High-Pressure Components, Ltd.
I.V. Pressure Controllers, Ltd.
Kautex, Ltd.
Kidde Co., Ltd., The Walter
Maricon, Ltd.
Newton and Co., H. T.
Palmer Tyre, Ltd., The
Plessey Group
Skyhi, Ltd.
Siebe, Gorman and Co., Ltd.
Super Oil Seals and Gaskets, Ltd.
Wilkinson Rubber Linatex, Ltd.

HYDRAULIC EQUIPMENT

Aerocontacts (Sales), Ltd.
Automotive Products Co., Ltd.
Avica Equipment, Ltd.
Boulton Paul Aircraft, Ltd.
British Messier, Ltd.
Chamberlain Industries, Ltd.
Dowty Equipment, Ltd.
Dunlop Rubber Co., Ltd.
Electro-Hydraulics, Ltd.
Fielding and Platt, Ltd.
H.M.L. (Engineering), Ltd.
Hale Hamilton and Co., Ltd.
High Pressure Components, Ltd.
Hobson, Ltd., H. M.
I.V. Pressure Controllers, Ltd.
Integral, Ltd.

(Continued overleaf)

Decca lightweight Flight Log, Type 720.

THE ANCILLARY INDUSTRY . . .

Hydraulic Equipment (Continued)

King Aircraft Corporation
Lucas (Gas Turbine Equipment), Ltd., Joseph
Newton and Co., H. T.
Palmer Tyre, Ltd., The
Plessey Group
Portsmouth Aviation, Ltd.
Reilly Engineering, Ltd.
Rollason Aerocessories, Ltd.
Rubery, Owen and Co., Ltd.
Saunders Valve Co., Ltd.
Skyhi, Ltd.
Sperry Gyroscope Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.
Tecalemit, Ltd.
Walter, A. J.
Westminster Airways Servicing, Ltd.
Wilmot Breeden, Ltd.

IGNITION EQUIPMENT

Aerocontacts (Sales), Ltd.
Avica Equipment, Ltd.
British Thomson-Houston Co., Ltd., The
Eagle Aircraft Services, Ltd.
Eastern Aero Electrical Services, Ltd.
K.L.G. Plugs, Ltd.
Lodge Plugs, Ltd.
Newton and Co., H. T.
Plessey Group
Rollason Engines, Ltd.
Rotax, Ltd.
Scintilla, Ltd.
Smiths Aircraft Instruments, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Walter, A. J.

INSPECTION EQUIPMENT

Aerocontacts (Sales), Ltd.
Avimo of Taunton
Engineering Products, Ltd.
Field Aircraft Services, Ltd.
Miles, Ltd., F. G.
Optical Measuring Tools, Ltd.
Pullin and Co., Ltd., R. B.
Pye, Ltd.
R.F.R. Patents, Ltd.
Rollason Aerocessories, Ltd.
Teleflex Products, Ltd.

INSTRUMENTS, AIRCRAFT AND NAVIGATIONAL

A.J.W. (Instruments), Ltd.
Aerocontacts (Sales), Ltd.
Brown, Ltd., S. G.
Cole, Ltd., E. K.
Decca Navigator Co., Ltd., The
Dent and Co. and Johnson, Ltd.
Dundas, Ltd., R. K.
Eagle Aircraft Services, Ltd.
Ekco Electronics, Ltd.
Elliott Brothers (London), Ltd.
Ferranti, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Graseby Instruments, Ltd.
Integral, Ltd.
Kelvin and Hughes (Aviation), Ltd.
Kent, Ltd., George
Mechanism, Ltd.
Muir and Adie, Ltd.
Munro, Ltd., R. W.
Murphy Radio, Ltd.
Negretti and Zambra, Ltd.
Newmark, Ltd., Louis
Newton and Co., H. T.
Pullin and Co., Ltd., R. B.
Pye, Ltd.
Reid and Sigrist, Ltd.
Salford Electrical Instruments, Ltd.
Sangamo Weston, Ltd.
Simmonds Aerocessories, Ltd.
Smiths Aircraft Instruments, Ltd.
Speke Instrument Co.
Sperry Gyroscope Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.
Teddington Aircraft Controls, Ltd.
Waymouth Gauges and Instruments, Ltd.
Wynn and Co. (Aircraft), Ltd., E. D.
Wynnstruments, Ltd.
Z. and I. Aero Services, Ltd.

INSTRUMENTS, OTHER THAN ABOVE.—see Testing Equipment

INSULATION, ELECTRICAL

Aerocontacts (Sales), Ltd.
Crane Packing, Ltd.
Dawe Instruments, Ltd.
Fibreglass, Ltd.
General Electric Co., Ltd., The
Imperial Chemical Industries, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Tufnol, Ltd.
Turner Brothers Asbestos Co., Ltd.
Wallington Weston and Co., Ltd.

Combined Machmeter and A.S.I. (Kelvin and Hughes, Ltd.).

INSULATION, SOUND

Anticoustic Co., The
Baynes Aircraft Interiors, Ltd.
Bell's Asbestos and Engineering, Ltd.
Cullum and Co., Ltd., Horace W.
Detuners, Ltd.
Fibreglass, Ltd.
Jablo Plastics Industries, Ltd.
Rumbold and Co., Ltd., L. A.

INSULATION, THERMAL

B. X. Plastics, Ltd.
Baynes Aircraft Interiors, Ltd.
Bell's Asbestos and Engineering, Ltd.
British Belting and Asbestos, Ltd.
Burnley Aircraft Products, Ltd.
Chemring, Ltd.
Delaney Gallay, Ltd.
Expanded Rubber Co., Ltd.
Fibreglass, Ltd.
Jablo Plastics Industries, Ltd.
Rumbold and Co., Ltd., L. A.
Turner Brothers Asbestos Co., Ltd.

INSURANCE

Airwork, Ltd.
British Aviation Insurance Co., Ltd. The
Dundas, Ltd., R. K.
Eagle Aircraft Services, Ltd.
Park, Ltd., R. and J.

JACKS, HYDRAULIC

Aerocontacts (Sales), Ltd.
Aero Maintenance Equipment, Ltd.
Automotive Products Co., Ltd.
Boulton Paul Aircraft, Ltd.
British Messier, Ltd.
Brown Brothers (Aircraft), Ltd.
Courtney and Co., Ltd., Ross.
Dowty Equipment, Ltd.
Electro-Hydraulics, Ltd.
Field Aircraft Services, Ltd.
Power Jacks, Ltd.
Reilly Engineering, Ltd.
Rubery, Owen and Co., Ltd.
Skyhi, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Walter, A. J.
Western Manufacturing (Reading), Ltd.
Westminster Airways Servicing, Ltd.
Wilmot Breeden, Ltd.

JACKS, SCREW

Aerocontacts (Sales), Ltd.
Aero Controls, Ltd.
Aero Maintenance Equipment, Ltd.
Brown Brothers (Aircraft), Ltd.
Field Aircraft Services, Ltd.
Hobson, Ltd., H. M.
Opperman, Ltd., S. E.
Reilly Engineering, Ltd.
Ross, Ltd., S. Grahame
Rotax, Ltd.
Stewart Aeronautical Supply Co., Ltd.

JIG ASSEMBLY MATRIX AND TUBE-BENDING ALLOYS

Mining and Chemical Products, Ltd.

JIGS AND FIXTURES

Aero Controls, Ltd.
Aircraft Engineering and Jigs, Ltd.
Airflow Streamlines, Ltd.
Balfour and Co., Ltd., Arthur
Brooke Tool Manufacturing Co., Ltd., The
Burgess and Co., Ltd., G. H.
Corner and Co., Ltd., G.
Dancer and Hearne Bros., Ltd.
Dart Aircraft, Ltd.
Dent and Co. and Johnson, Ltd.
Gloster Engineering (Cheltenham), Ltd.
Helliwells, Ltd.
Jameson Aero Engines, Ltd.
King Aircraft Corporation
Leytonstone Jig and Tool Co., Ltd.
Miles, Ltd., F. G.
Mollart Engineering Co., Ltd., The
Morris, Ltd., B. O.
Opperman, Ltd., S. E.
Plessey Group
Rollason Aerocessories, Ltd.
Samlesbury Engineering, Ltd.
Tufnol, Ltd.
Thompson (Engineers), Ltd., Raymond F.
Welsh Metal Industries, Ltd.
Westminster Airways Servicing, Ltd.

JIGS AND FIXTURES, STANDARD PARTS FOR

Plessey Group
Purefoy Unit Tooling, Ltd., J. B.

JOINTING MATERIALS, FITTINGS AND COMPOUNDS (see also Sealants)

Aerocontacts (Sales), Ltd.
Aircraft Materials, Ltd.
B.B. Chemical Co., Ltd.
Bell's Asbestos and Engineering, Ltd.
British Belting and Asbestos, Ltd.
Crane Packing, Ltd.
Dowty Equipment, Ltd.
Dowty Seals, Ltd.
Dunlop Rubber Co., Ltd.
Expanded Rubber Co., Ltd.
Field Aircraft Services, Ltd.
Fireproof Tanks, Ltd.
Goodyear Tyre and Rubber Co. (Great Britain), Ltd., The
Hall and Hall, Ltd.
Jablo Plastics Industries, Ltd.
Kautex, Ltd.
Kenilworth Manufacturing Co., Ltd., The
Miller Aviation, Ltd.
Newton and Co., H. T.
Palmer Tyre, Ltd., The
Precision Rubbers, Ltd.
Ryland, Ltd., Llewellyn
Super Oil Seals and Gaskets, Ltd.
Titanine, Ltd.
Tufnol, Ltd.
Turner Brothers Asbestos Co., Ltd.
Walker and Co., Ltd., James
Wallington Weston and Co., Ltd.
Wellworthy, Ltd.
Wilkinson Rubber Linatex, Ltd.
Wills Pressure Filled Joint Ring, Ltd.

LABORATORY EQUIPMENT

A.J.W. (Instruments), Ltd.
Amal, Ltd.
Bryans Aeroquipment, Ltd.
Dawe Instruments, Ltd.
Elliott Brothers (London), Ltd.
General Electric Co., Ltd., The
Goodmans Industries, Ltd.
Graseby Instruments, Ltd.
McMichael Radio, Ltd.
Measuring Instruments (Pullin), Ltd.
Murphy Radio, Ltd.
Plessey Group
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame
Saunders Valve Co., Ltd.
Southern Instruments, Ltd.
Vernons Industries, Ltd.

LANDING GEAR

Aircraft Spares and Components
Automotive Products Co., Ltd.
Boulton Paul Aircraft, Ltd.
British Messier, Ltd.
Dowty Equipment, Ltd.
Eagle Aircraft Services, Ltd.
Electro-Hydraulics, Ltd.
Fairey Aviation Co., Ltd., The
Field Aircraft Services, Ltd.
Newton and Co., H. T.
Opperman, Ltd., S. E.
Rollason, Ltd., W. A.

LIFE-SAVING EQUIPMENT, OTHER THAN PARACHUTES

Aerocontacts (Sales), Ltd.
Aircraft Materials, Ltd.
Black and Decker, Ltd.
British Communications Corporation, Ltd.
Burgess and Co., Ltd., G. H.
Burndept, Ltd.
Chemring, Ltd.
Dundas, Ltd., R. K.
Easco Electrical (Holdings), Ltd.
Elliot Equipment, Ltd.
Expanded Rubber Co., Ltd.
Field Aircraft Services, Ltd.
Frankenstein and Sons (Manchester), Ltd., P.
Hadley Co., Ltd., The
Kidde Co., Ltd., The Walter
King Aircraft Corporation
Lea Bridge Industries, Ltd.
M. L. Aviation Co., Ltd.
Martin-Baker Aircraft Co., Ltd.
R.F.D. Co., Ltd.
Schermuly Pistol Rocket Apparatus, Ltd., The
Siebe, Gorman and Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.
Thermo-Plastics, Ltd.
Ultra Electric, Ltd.

LIGHTING EQUIPMENT, AIRCRAFT

Aerocontacts (Sales), Ltd.
Aviation Traders, Ltd.
Baynes Aircraft Interiors, Ltd.
British Thomson-Houston Co., Ltd., The
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Harley Aircraft Landing Lamps
Newton and Co., H. T.
Rotax, Ltd.
Scottish Aviation, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Thorn Electrical Industries, Ltd.
Venner, Ltd.
Wilmot Breeden, Ltd.

LIGHTING EQUIPMENT, AIRFIELD

Aerocontacts (Sales), Ltd.
British Thomson-Houston Co., Ltd., The
Elliott Brothers (London), Ltd.
General Electric Co., Ltd., The
Harley Aircraft Landing Lamps
Newton and Co., H. T.
Revo Electric Co., Ltd.
Standard Telephones and Cables, Ltd.

(*Continued on p. 419*)

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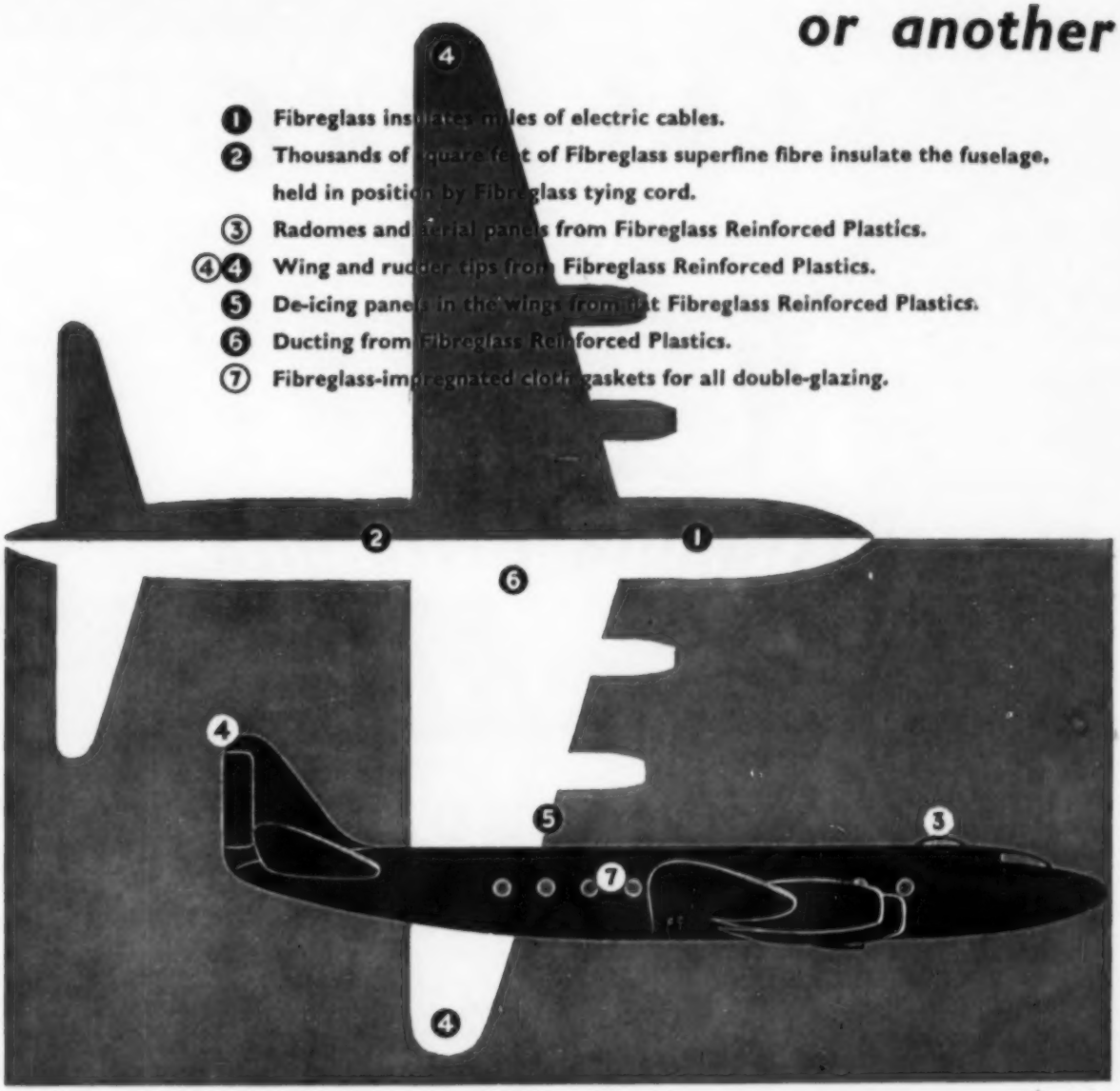

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Westinghouse Brake and Signal Co., Ltd.

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Elliott Brothers (London), Ltd.
General Electric Co., Ltd., The
Oldham and Son, Ltd.
Revo Electric Co., Ltd.
Rover Gas Turbines, Ltd.
Thorn Electrical Industries, Ltd.

LOCKNUTS
Aerocontacts (Sales), Ltd.
Aircraft Materials, Ltd.
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Guest Keen and Nettlefolds (Midlands), Ltd.
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Newton and Co., H. T.
Newton and Co., Ltd., L. H.
Simmonds Aerocessories, Ltd.
Rollason, Ltd., W. A.
Rubery, Owen and Co., Ltd.
Tufnol, Ltd.
Whitehouse Industries, Ltd.

LOCKS, DOOR
Baynes Aircraft Interiors, Ltd.
King Aircraft Corporation
Midland Aeroquipment, Ltd.
Ross, Ltd., S. Grahame
Wilmot Breeden, Ltd.

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Aircraft Materials, Ltd.
B.P. Aviation Service
Esso Petroleum Co., Ltd.
Jenolite, Ltd.
Ragosine Oil Co., Ltd.
Regent Oil Co., Ltd.
Shell-Mex and B.P., Ltd.
Vacuum Oil Co., Ltd.
Wakefield and Co., Ltd., C. C.

LUBRICATING EQUIPMENT FOR SERVICING
Tecalemit, Ltd.
Thompson Bros. (Bilston), Ltd.
Wakefield and Co., Ltd., C. C.

MAGNESIUM AND ITS ALLOYS
Aircraft Materials, Ltd.
Birmetals, Ltd.
Booth and Co., Ltd., James
Essex Aero, Ltd.
High Duty Alloys, Ltd.
Magnesium Elektron, Ltd.
Stone and Co. (Charlton), Ltd., J.
Wilson and Sons (London), Ltd., W.

MAGNETOS
Aeroservices, Ltd.
Air Engine Services (U.S.-U.K.), Ltd.
British Thomson-Houston Co., Ltd., The
Dundas, Ltd., R. K.
Eagle Aircraft Services, Ltd.
Eastern Aero Electrical Services, Ltd.
Field Aircraft Services, Ltd.
Newton and Co., H. T.
Rollason Engines, Ltd.
Rotax, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Walter, A. J.

MAPS
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Foldex, Ltd.
International Aeradio, Ltd.
Meridian Airmaps, Ltd.

MARINE CRAFT
Fairey Aviation Co., Ltd., The
R.F.D. Co., Ltd.
Samlesbury Engineering, Ltd.
Saunders-Roe, Ltd.
Vosper, Ltd.
Walter, A. J.

MARINE AIRCRAFT SERVICING EQUIPMENT
Ross, Ltd., S. Grahame
Saunders-Roe, Ltd.
Zwicky, Ltd.

MECHANICAL HANDLING EQUIPMENT (other than Tractors and Trucks)
Atlas Diesel Co., Ltd.
Eccles (Birmingham), Ltd.
Hymatic Engineering Co., Ltd., The
Mercury Truck and Tractor Co., Ltd., The
Partridge, Wilson and Co., Ltd.
Portsmouth Aviation, Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame
Skyhi, Ltd.
Teleflex Products, Ltd.
Vernons Industries, Ltd.
Wilmot Breeden, Ltd.

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Coley and Son (Hounslow), Ltd., R. J.

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Flight Refuelling, Ltd.
Opperman, Ltd., S. E.
V.P. Sheet Metal, Ltd.

METEOROLOGICAL INSTRUMENTS AND EQUIPMENT
Aerocontacts (Sales), Ltd.
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Decca Radar, Ltd.
Dundas, Ltd., R. K.
International Aeradio, Ltd.
Kelvin and Hughes (Aviation), Ltd.
Mullard, Ltd.
Munro, Ltd., R. W.
Negretti and Zambra, Ltd.
Newton and Co., H. T.
Salford Electrical Instruments, Ltd.
Short and Mason, Ltd.
Suchy Holdings Group
Thermionic Products, Ltd.

MICROPHONES
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Brown, Ltd., S. G.
Easco Electrical (Holdings), Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Lewis, Ltd., D.
Marconi's Wireless Telegraph Co., Ltd.
Murphy Radio, Ltd.
Newton and Co., H. T.
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.
Z. and I. Aero Services, Ltd.

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Briggs Motor Bodies, Ltd.
British Messier, Ltd.
Brown, Ltd., S. G.
Burnley Aircraft Products, Ltd.
de Havilland Propellers, Ltd.
Dowty Equipment, Ltd.
Dunlop Rubber Co., Ltd.
Elliott Brothers (London), Ltd.
English Electric Co., Ltd.
Essex Aero, Ltd.
Fairey Aviation Co., Ltd., The
Flight Refuelling, Ltd.
General Electric Co., Ltd., The
Graseby Instruments, Ltd.
Graviner Manufacturing Co., Ltd.
Hadfields, Ltd.
Hobson, Ltd., H. M.
I. V. Pressure Controllers, Ltd.
Jameson Aero Engines, Ltd.
Lancefield Aircraft Components, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Marston Excelsior, Ltd.
Miles, Ltd., F. G.
Napier and Son, Ltd., D.
Newmark, Ltd., Louis
Portsmouth Aviation, Ltd.
Pullin and Co., Ltd., R. B.
Redwing, Ltd.
Reilly Engineering, Ltd.
Rotol, Ltd.
Samlesbury Engineering, Ltd.
Sankey and Sons, Ltd., Joseph
Sperry Gyroscope Co., Ltd.
Technograph Printed Circuits, Ltd.
Thermo-Plastics, Ltd.
Thompson Bros. (Bilston), Ltd.
V.P. Sheet Metal, Ltd.
Wilmot Breeden, Ltd.

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Hunting Aerosurveys, Ltd.
Shawcraft
Suntex Safety Glass Industries, Ltd.
Westway Models, Ltd.

MOTORS, ELECTRIC
Aerocontacts (Sales), Ltd.
Avionics, Ltd.
British Thomson-Houston Co., Ltd., The
Brown, Ltd., S. G.
City Electrical Co.
English Electric Co., Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Newton and Co., H. T.
Newton Brothers (Derby), Ltd.
Plessey Group
Pullin and Co., Ltd., R. B.
Rotax, Ltd.
Rotol, Ltd.
Short Brothers and Harland, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Vernons Industries, Ltd.
Whittemore (Aeradio), Ltd., A. J.

MOUNTINGS, SHOCK-ABSORBING
Aerocontacts (Sales), Ltd.
British Messier, Ltd.
Cementation (Muffelite), Ltd.
Dowty Equipment, Ltd.
Dunlop Rubber Co., Ltd.
Dunlop Special Products, Ltd.
Easipower, Ltd.
Field Aircraft Services, Ltd.
Girling, Ltd.
Jablo Plastics Industries, Ltd.
M.H.H. Engineering Co., Ltd.
Newton and Co., H. T.
Newton and Co., Ltd., L. H.
Opperman, Ltd., S. E.
Silentbloc, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Tufnol, Ltd.

NAMEPLATES
Blundell Rules, Ltd.
London Name Plate Manufacturing Co., Ltd., The
Rollason, Ltd., W. A.
Ross, Ltd., S. Grahame
Tufnol, Ltd.
Vosper, Ltd.

NAVIGATORS' PERSONAL INSTRUMENTS
Aerocontacts (Sales), Ltd.
Blundell Rules, Ltd.
Kelvin and Hughes (Aviation), Ltd.
Newton and Co., H. T.
Stewart Aeronautical Supply Co., Ltd.

NUTS.—see A.G.S. Parts, also Locknuts

OIL COOLERS
Aeroservices, Ltd.
Delaney Gallay, Ltd.
Field Aircraft Services, Ltd.
Marston Excelsior, Ltd.
Newton and Co., H. T.
Serck Radiators, Ltd.
V.P. Sheet Metal, Ltd.
Walter, A. J.

OVERHAUL, ENGINE (see also Servicing)
Aeroservices, Ltd.
Derby Aviation, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Rollason Engines, Ltd.
Samlesbury Engineering, Ltd.
Scottish Aviation, Ltd.
Vosper, Ltd.

OXYGEN AND EQUIPMENT
Aerocontacts (Sales), Ltd.
Avimo of Taunton
British Oxygen Co., Ltd., The
Chemring, Ltd.
Field Aircraft Services, Ltd.
Graseby Instruments, Ltd.
Hadley Co., Ltd., The
I.V. Pressure Controllers, Ltd.
Kidde Co., Ltd., The Walter
Lewis, Ltd., D.
Normalair, Ltd.
Rollason Aerocessories, Ltd.
Saunders Valve Co., Ltd.
Siebe, Gorman and Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.
Suchy Holdings Group

PACKAGING AND DISPATCH
Burnley Aircraft Products, Ltd.
Export Packing Service, Ltd.
Gosheron and Co., Ltd., John
Jablo Plastics Industries, Ltd.
Lep Transport, Ltd.
Park, Ltd., R. and J.
Reynolds (Packaging), Ltd.
Salter and Co., Ltd., Geo.
Samlesbury Engineering, Ltd.
Shackleton, Ltd., W. S.

PACKAGING EQUIPMENT
B.X. Plastics, Ltd.
Feltham and Son, Ltd., Walter H.
Jablo Plastics Industries, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Xetal Products, Ltd.

PACKINGS.—see Jointing Materials

PAINTS, OTHER THAN AIRCRAFT FINISHES AND PROTECTIVE PROCESSES
Aerocontacts (Sales), Ltd.
British Aluminium Co., Ltd., The
Cellon, Ltd.
Docker Brothers
Dunlop Special Products, Ltd.
Hall and Sons (Bristol and London), Ltd., John
Imperial Chemical Industries, Ltd.
Kenilworth Manufacturing Co., Ltd. The
Modern Industrial Finishes, Ltd.
Ryland, Ltd., Llewellyn
Thompson, Bros (Bilston), Ltd.
Titanine, Ltd.
Vulcan Products, Ltd.

PAINT REMOVERS
Aerocontacts (Sales), Ltd.
Aeroservices, Ltd.
Brent Chemical Products, Ltd.
Cellon, Ltd.
Docker Brothers
Imperial Chemical Industries, Ltd.
Jenolite, Ltd.
Modern Industrial Finishes, Ltd.
Paint Removers, Ltd.
Ryland, Ltd., Llewellyn
Titanine, Ltd.
Valay Industries, Ltd.
Vulcan Products, Ltd.

PARACHUTES
Chemring, Ltd.
Dundas, Ltd., R. K.
Elliot Equipment, Ltd.
Field Aircraft Services, Ltd.
G. Q. Parachute Co., Ltd.
Irving Air Chute of Great Britain, Ltd.
Lea Bridge Industries, Ltd.

PARTS, MACHINED
Aero Controls, Ltd.
Aircraft Engineering and Jigs, Ltd.
Aviation Traders (Engineering), Ltd.
Avionics, Ltd.
Balfour and Co., Ltd., Arthur
Birkett, Billington and Newton, Ltd., T. M.
Brown Brothers (Aircraft), Ltd.
British Wire Products, Ltd.
Burgess and Co., Ltd., G. H.
Dart Aircraft, Ltd.
Engineering Products, Ltd.
Field Aircraft Services, Ltd.
Graseby Instruments, Ltd.
Hadfields, Ltd.
Helliwells, Ltd.
Leytonstone Jig and Tool Co., Ltd.
M.H.H. Engineering Co., Ltd.
Mollart Engineering Co., Ltd., The
Newton and Co., H. T.
Newton and Co., Ltd., L. H.
Opperman, Ltd., S. E.
Plessey Group
Redwing, Ltd.
Rollason Aerocessories, Ltd.
Rolls Razor, Ltd.
Ross, Ltd., S. Grahame.

(Continued overleaf)

THE ANCILLARY INDUSTRY . . .

Parts, Machined (Continued)
Thompson (Engineers), Ltd., Raymond F.
Tiltman Langley, Ltd.
Tufnol, Ltd.
V.P. Sheet Metal, Ltd.
Whittemore (Aeradio), Ltd., A. J.
Y.S.C., Ltd., The
Yorkshire Engineering Supplies, Ltd.

PARTS, TUBULAR
Accles and Pollock, Ltd.
Reynolds Tube Co., Ltd.

PHOTOGRAPHY, AERIAL
Air Survey Co., Ltd.
Fairey Aviation Co., Ltd., The
Hunting Aerosurveys, Ltd.
Ilford, Ltd.
Kodak, Ltd.
Meridian Airmaps, Ltd.
Stewart Aeronautical Supply Co., Ltd.

PHOTOGRAPHY, GENERAL
Graseby Instruments, Ltd.
Ilford, Ltd.
Kodak, Ltd.
Meridian Airmaps, Ltd.

PHOTOGRAMMETRIC EQUIPMENT
Aerocontacts (Sales), Ltd.
Dart Aircraft, Ltd.

PISTONS AND RINGS
Air Engine Services (U.S.-U.K.), Ltd.
Field Aircraft Services, Ltd.
Hepworth and Grandage (Yeadon), Ltd.
Newton and Co., H. T.
Rollason Engines, Ltd.
Walter, A. J.
Wellworthy, Ltd.

PLASTICS, EXPANDED
Expanded Rubber Co., Ltd.
Jablo Plastics Industries, Ltd.

PLASTICS, EXTRUSIONS
B.X. Plastics, Ltd.
Bakelite, Ltd.
Crane Packing, Ltd.
Hellermann, Ltd.
Rist's, Wires and Cables, Ltd.
Tufnol, Ltd.
Wallington Weston and Co., Ltd.

PLASTICS, FABRICATED
Aeroplastics, Ltd.
Aston and Co., Ltd., E. S.
Blundell Rules, Ltd.
British Emulsifiers, Ltd.
Crane Packing, Ltd.
Dowty Seals, Ltd.
Fairey Aviation Co., Ltd., The
General Electric Co., Ltd., The
Hadley Co., Ltd., The
Jablo Plastics Industries, Ltd.
Les Bridge Industries, Ltd.
Miles, Ltd., F. G.
Opperman, Ltd., S. E.
Suntex Safety Glass Industries, Ltd.
Thermo-Plastics, Ltd.
Triplex Safety Glass Co., Ltd., The
Tufnol, Ltd.
Uhlhorn Bros., Ltd.
Wallington Weston and Co., Ltd.

PLASTICS, GLASS FIBRE
Aeroplastics, Ltd.
Bakelite, Ltd.
British Emulsifiers, Ltd.
Chelton (Electrostatics), Ltd.
Crane Packing, Ltd.
Dart Aircraft, Ltd.
Fothergill and Harvey (Sales), Ltd.
Gloster Engineering (Cheltenham), Ltd.
Hordern-Richmond (Sales), Ltd.
Insulators, Ltd.
Jablo Plastics Industries, Ltd.
Kidde Co., Ltd., The Walter
Marston Excelsior, Ltd.
Miles, Ltd., F. G.
Saunders-Roe, Ltd.
Suntex Safety Glass Industries, Ltd.
Thermo-Plastics, Ltd.

PLASTICS, LAMINATED
Aeroplastics, Ltd.
Aston and Co., Ltd., E. S.
Bakelite, Ltd.
Brand and Co., Ltd., R. A.
Dart Aircraft, Ltd.
Hordern-Richmond (Sales), Ltd.
Jablo Plastics Industries, Ltd.
Marston Excelsior, Ltd.
Miles, Ltd., F. G.
Shawcraft
Suntex Safety Glass Industries, Ltd.
Thermo-Plastics, Ltd.
Tufnol, Ltd.
Uhlhorn Bros, Ltd.
Wallington Weston and Co., Ltd.

PLASTICS, MOULDED
Aeroplastics, Ltd.
Attewell and Sons, Ltd., B.
Bakelite, Ltd.
British Artid Plastics, Ltd.
Chelton (Electrostatics), Ltd.
Cole, Ltd., E. K.
Cornercroft, Ltd.
Crane Packing, Ltd.
General Electric Co., Ltd., The
Graviner Manufacturing Co., Ltd.
Hadley Co., Ltd., The
Hellermann, Ltd.
Insulators, Ltd.
Jablo Plastics Industries, Ltd.
M.L. Aviation Co., Ltd.
Miles, Ltd., F. G.
Rolls Razor, Ltd.
Suntex Safety Glass Industries, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Thermo-Plastics, Ltd.
Tufnol, Ltd.
Uhlhorn Bros., Ltd.
Wayne Kerr Laboratories, Ltd., The
Wilmot Breeden, Ltd.

PLASTICS, RAW MATERIALS
B.X. Plastics, Ltd.
British Oxygen Co., Ltd., The
Fothergill and Harvey (Sales), Ltd.
Imperial Chemical Industries, Ltd.
Kodak, Ltd.
Miles, Ltd., F. G.
Turner Brothers Asbestos Co., Ltd.
Uhlhorn Bros., Ltd.
Wallington Weston and Co., Ltd.

PLASTICS, GLASS FIBRE, RAW MATERIAL
Fibreglass, Ltd.

PLASTICS, SHEETING
B.X. Plastics, Ltd.
Brand and Co., Ltd., R. A.
Cox and Son, Ltd., John
Crane Packing, Ltd.
General Electric Co., Ltd., The
Kodak, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Thermo-Plastics, Ltd.
Tufnol, Ltd.
Uhlhorn Bros., Ltd.
Wallington Weston and Co., Ltd.

PLATING, ELECTRO-
Aircraft Engineering and Jigs, Ltd.
Essex Aero, Ltd.
Flight Refuelling, Ltd.
Opperman, Ltd., S. E.
Suchy Holdings Group
Westinghouse Brake and Signal Co., Ltd.
Wilmot Breeden, Ltd.

PLATING EQUIPMENT, ELECTRO-
Aerocontacts (Sales), Ltd.
Partridge Wilson and Co., Ltd.
Standard Telephones and Cables, Ltd.
Westinghouse Brake and Signal Co., Ltd.

PLUGS, SPARKING AND IGNITER
Aerocontacts (Sales), Ltd.
Dundas, Ltd., R. K.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
K.L.G. Plugs, Ltd.
Lodge Plugs, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Smith's Aircraft Instruments, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Walter, A. J.

PLYWOOD
Aerocontacts (Sales), Ltd.
Dundas, Ltd., R. K.
Field Aircraft Services, Ltd.
Jablo Plastics Industries, Ltd.

PNEUMATIC SYSTEMS
Dunlop Rubber Co., Ltd.
Graseby Instruments, Ltd.
Hymatic Engineering Co., Ltd., The
Newton and Co., H. T.
Reilly Engineering, Ltd.
Rollason Aerocessories, Ltd.
Saunders Valve Co., Ltd.
V. P. Sheet Metal, Ltd.

PRESSURE VESSELS
Chesterfield Tube Co., Ltd., The
Dowty Equipment, Ltd.
Dunlop Rubber Co., Ltd.
Flight Refuelling, Ltd.
Hadfields, Ltd.
Hymatic Engineering Co., Ltd., The
Lacy-Hulbert and Co., Ltd.
Miles, Ltd., F. G.
Reynolds Tube Co., Ltd.
Rollason Aerocessories, Ltd.
Siebe, Gorman and Co., Ltd.
Thermo-Plastics, Ltd.
Thompson Bros. (Bilston), Ltd.

PRESSURIZATION EQUIPMENT.—see Air Conditioning

PRESSWORK
Airflow Streamlines, Ltd.
Attewell and Sons, Ltd., B.
Bramah and Co., Ltd., J. R.
Briggs Motor Bodies, Ltd.
British Emulsifiers, Ltd.
Brown Brothers (Aircraft), Ltd.
Burgess and Co., Ltd., G. H.
Burnley Aircraft Products, Ltd.
Chemring, Ltd.
Chinn and Co., Ltd., J. S.
Corner and Co., Ltd., G.
Cornercroft, Ltd.
Easipower, Ltd.
Essex Aero, Ltd.
Helliwells, Ltd.
Henderson Safety Tank Co., Ltd., The
Heston Aircraft Co., Ltd., The
Jablo Plastics Industries, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Marston Excelsior, Ltd.
Miles, Ltd., F. G.
Newton and Co., Ltd., L. H.
Pressed Steel Co., Ltd.
Redwing, Ltd.
Rolls Razor, Ltd.
Rubery, Owen and Co., Ltd.
Sankey and Sons, Ltd., Joseph
Scottish Aviation, Ltd.
Steel Stampings, Ltd.
Terry and Sons, Ltd., Herbert
Thompson Bros. (Bilston), Ltd.
Thompson (Engineers), Ltd., Raymond F.
V.P. Sheet Metal, Ltd.
Vernons Industries, Ltd.
Western Manufacturing (Reading), Ltd.
Wilmot Breeden, Ltd.

PROPELLERS.—see Airscrews

PROTECTIVE PROCESSES (other than aircraft finishes)
Anticoustic Co., The
Brand and Co., Ltd., R. A.
Corner and Co., Ltd., G.
Essex Aero, Ltd.
Esso Petroleum Co., Ltd.
Imperial Chemical Industries, Ltd.
Jenolite, Ltd.
Modern Industrial Finishes, Ltd.
Pyrene Co., Ltd., The
Telegraph Construction and Maintenance Co., Ltd., The
Titanine, Ltd.
Valay Industries, Ltd.
Walterisation Co., Ltd., The

PUBLICATIONS, TECHNICAL AND GENERAL
English Universities Press, Ltd.
Faber and Faber, Ltd.
Helliwells, Ltd.
Hutchinson and Co. (Publishers), Ltd.
Iliffe and Sons, Ltd.
Methuen and Co., Ltd.
Pitman and Sons, Sir Isaac
Scottish Aviation, Ltd.

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British Thomson-Houston Co., Ltd., The
Easco Electrical (Holdings), Ltd.
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Murphy Radio, Ltd.
Pye, Ltd.
Redifon, Ltd.
Standard Telephones and Cables, Ltd.

PUMPS, AIR PRESSURE AND VACUUM
Aerocontacts (Sales), Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Hymatic Engineering Co., Ltd., The
Lacy-Hulbert and Co., Ltd.
Newton and Co., H. T.
Plessey Group.
Pulsometer Engineering Co., Ltd., The
Rollason Aerocessories, Ltd.
Rotax, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Walter, A. J.

PUMPS, FUEL AND OIL
Aerocontacts (Sales), Ltd.
Aeroservices, Ltd.
Amal, Ltd.
Dowty Fuel Systems, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Hobson, Ltd., H. M.
Integral, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph.
Newton and Co., H. T.
Plessey Group.
Pulsometer Engineering Co., Ltd., The
Rollason Engines, Ltd.
Rotax, Ltd.
Rover Gas Turbines, Ltd.
Self-Priming Pump and Engineering Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.
Thompson Bros. (Bilston), Ltd.
Wakefield and Co., Ltd., C. C.
Walter, A. J.
Wayne Tank and Pump Co., Ltd.
Wilmot Breeden, Ltd.
Zwicky, Ltd.

PUMPS, HYDRAULIC
Aerocontacts (Sales), Ltd.
Aeroservices, Ltd.
Automotive Products Co., Ltd.
British Messier, Ltd.
Dowty Equipment, Ltd.
Field Aircraft Services, Ltd.
Fielding and Platt, Ltd.
H.M.L. (Engineering), Ltd.
Hobson, Ltd., H. M.
Integral, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Newton and Co., H. T.
Plessey Group
Power Jacks, Ltd.
Pulsometer Engineering Co., Ltd., The
Reilly Engineering, Ltd.
Rollason Aerocessories, Ltd.
Rubery, Owen and Co., Ltd.
Sperry Gyroscope Co., Ltd.
Skyhi, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Walter, A. J.

PYROTECHNICS
Aerocontacts (Sales), Ltd.
Schermuly Pistol Rocket Apparatus, Ltd., The
Stewart Aeronautical Supply Co., Ltd
Y.S.C., Ltd., The

Pye PTC 122/23/24 "Walkie-phone" transmitter/receiver.

RADAR EQUIPMENT
Aerocontacts (Sales), Ltd.
Aeronautical Radio Services, Ltd.
Airwork General Trading Co.
Avionics, Ltd.
British Thomson-Houston Co., Ltd., The
Burndept, Ltd.
Cole, Ltd., E. K.
Cossor Radar, Ltd.
Curran, Ltd., John
Decca Radar, Ltd.
E.R.S. (London), Ltd.
Ekco Electronics, Ltd.
Elliott Brothers (London), Ltd.
Ferranti, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Lancefield Aircraft Components, Ltd.
Marconi's Wireless Telegraph Co., Ltd.
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(Continued on p. 421)

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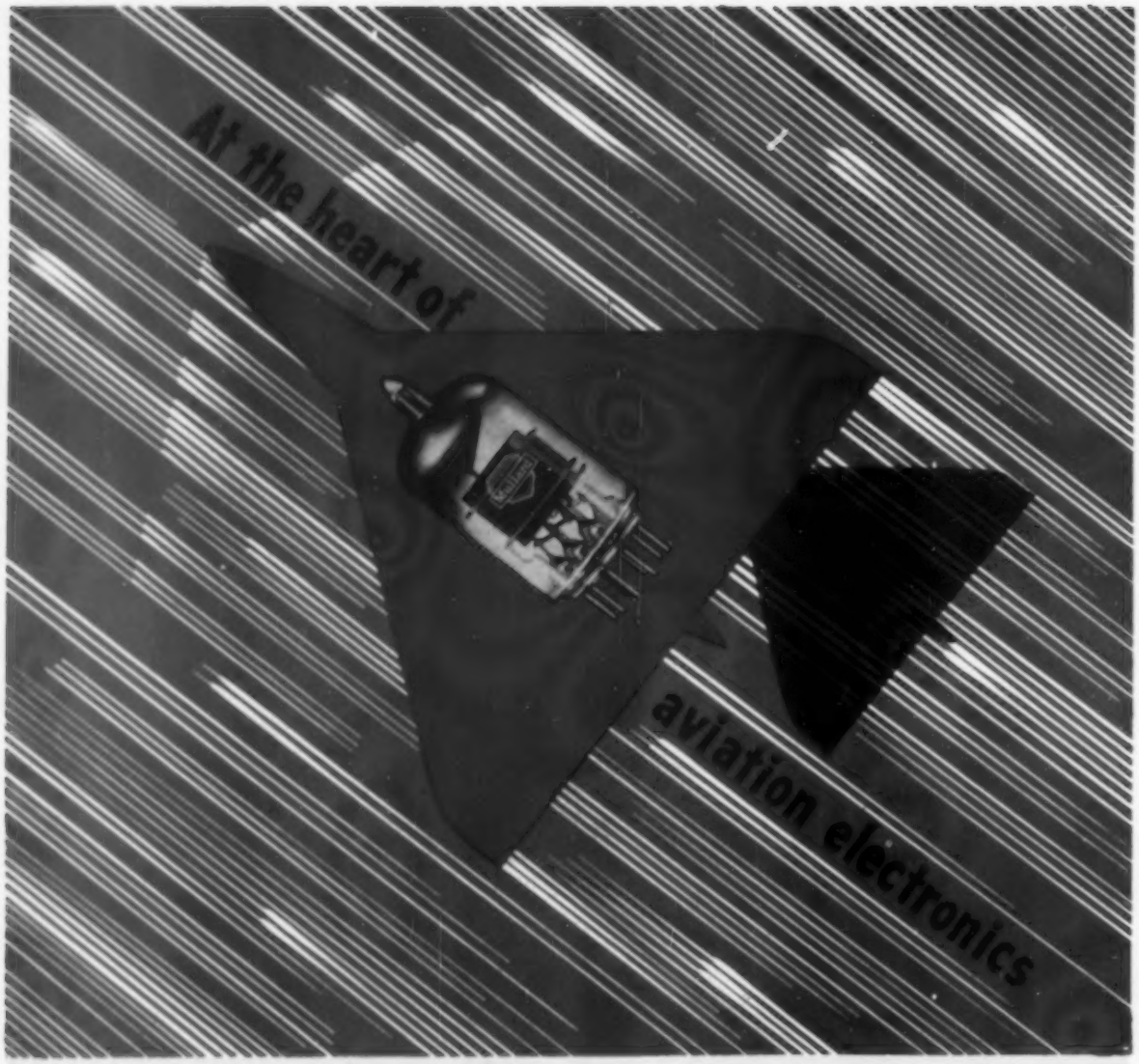

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Airwork General Trading Co.
Aviation Traders, Ltd.
Avionics, Ltd.
British Thomson-Houston Co., Ltd., The
Burndept, Ltd.
Chelton (Electrostatics), Ltd.
Cole, Ltd., E. K.
Decca Navigator Co., Ltd., The
E.R.S. (London), Ltd.
Eagle Aircraft Services, Ltd.
Ekco Electronics, Ltd.
Elliott Brothers (London), Ltd.
Ferranti, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Marconi's Wireless Telegraph Co., Ltd.
McMichael Radio, Ltd.
Mullard, Ltd.
Murphy Radio, Ltd.
Newton and Co., H. T.
Plessey Group
Pye, Ltd.
Racal, Ltd.
Racal Engineering, Ltd.
Redifon, Ltd.
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Thermionic Products, Ltd.
Thorn Electrical Industries, Ltd.
Whittemore (Aeradio), Ltd., A. J.
Z. and I. Aero Services, Ltd.

RADIO INSTALLATIONS, PLANNING AND SUPPLY OF
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Airwork General Trading Co.
Avionics, Ltd.
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Easco Electrical (Holdings), Ltd.
International Aeradio, Ltd.
Marconi's Wireless Telegraph Co., Ltd.
Mullard, Ltd.
Plessey Group
Pye, Ltd.
Racal, Ltd.
Racal Engineering, Ltd.
Rollason, Ltd., W. A.
Whittemore (Aeradio), Ltd., A. J.

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Aerocontacts (Sales), Ltd.
Avionics, Ltd.
Dawe Instruments, Ltd.
International Aeradio, Ltd.
Thermionic Products, Ltd.
Whittemore (Aeradio), Ltd., A. J.

RECTIFIERS
Aerocontacts (Sales), Ltd.
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Partridge, Wilson and Co., Ltd.
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Westinghouse Brake and Signal Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

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RELAYS, ELECTRICAL
Aerocontacts (Sales), Ltd.
Aircraft Spares and Components
Aviation Traders, Ltd.
Avionics, Ltd.
British Thomson-Houston Co., Ltd., The
Burndept, Ltd.
Cathodeon, Ltd.
Eagle Aircraft Services, Ltd.
Easipower, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Graseby Instruments, Ltd.
Hendrey Relays, Ltd.
Measuring Instruments (Pullin), Ltd.
Newton and Co., H. T.
Plessey Group
Pullin and Co., Ltd., R. B.
Rotax, Ltd.
Salford Electrical Instruments, Ltd.
Sanders (Electronics), Ltd., W. H.
Sangamo Weston, Ltd.
Smiths Aircraft Instruments, Ltd.
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Thorn Electrical Industries, Ltd.
Venner, Ltd.
Whittemore (Aeradio), Ltd., A. J.

RESISTORS
Aerocontacts (Sales), Ltd.
Aviation Traders, Ltd.
Avionics, Ltd.
British Thomson-Houston Co., Ltd., The
Dawe Instruments, Ltd.
Eagle Aircraft Services, Ltd.
Easipower, Ltd.
Field Aircraft Services, Ltd.
Newton and Co., H. T.
Pye, Ltd.
Rotax, Ltd.
Salford Electrical Instruments, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

RHEOSTATS
Aerocontacts (Sales), Ltd.
Avionics, Ltd.
British Thomson-Houston Co., Ltd., The
Easipower, Ltd.
Field Aircraft Services, Ltd.
Newton and Co., H. T.
Rotax, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

RIVETS.—see A.G.S. Parts

RIVETING EQUIPMENT
Aerocontacts (Sales), Ltd.
Aircraft Materials, Ltd.
Atlas Diesel Co., Ltd.
Aviation Developments, Ltd.
Brown Brothers (Aircraft), Ltd.
Tucker Eyelet Co., Ltd., George

RUBBER, GENERAL AND MECHANICAL (including synthetic rubbers and bonded components)
Bell's Asbestos and Engineering, Ltd.
Dowty Seals, Ltd.
Dunlop Rubber Co., Ltd.
Expanded Rubber Co., Ltd.
Fireproof Tanks, Ltd.
Goodyear Tyre and Rubber Co. (Great Britain), Ltd.
Hairlok Co., Ltd., The
Hall and Hall, Ltd.
Heinke and Co., Ltd., C. E.
Hellermann, Ltd.,
Jablo Plastics Industries, Ltd.
Kautex, Ltd.
Long and Hambly, Ltd.
Peradin and Watercraft, Ltd.
Precision Rubbers, Ltd.
Rist's, Wires and Cables, Ltd.
Silentbloc, Ltd.
Standard Insulator Co., Ltd., The
Super Oil Seals and Gaskets, Ltd.
Walker and Co., Ltd., James
Wallington Weston and Co., Ltd.
Wilkinson Rubber Linatex, Ltd.
Xetal Products, Ltd.

RUST REMOVERS AND INHIBITORS (see also Corrosion Inhibitors, and Protective Processes)
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Aircraft Materials, Ltd.
Bell's Asbestos and Engineering, Ltd.
Brent Chemical Products, Ltd.
Esso Petroleum Co., Ltd.
Imperial Chemical Industries, Ltd.
Jenolite, Ltd.
Modern Industrial Finishes, Ltd.
Pyrene Co., Ltd., The
Shell-Mex and B.P., Ltd.
Valay Industries, Ltd.
Wakefield and Co., Ltd., C.C.
Walterisation Co., Ltd., The

SAFETY EQUIPMENT.—see Life-saving Equipment

SALES, AIRCRAFT (including helicopters)
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Aeroservices, Ltd.
Air Engine Services (U.S.-U.K.), Ltd.
Airwork, Ltd.
Aviation Traders (Engineering), Ltd.
Avionics, Ltd.
Dart Aircraft, Ltd.
Derby Aviation, Ltd.
Dundas, Ltd., R. K.
Eagle Aircraft Services, Ltd.
Ferry Airports, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Helicopter Sales, Ltd.
Hunting Percival Aircraft, Ltd.
Miles, Ltd., F. G.
Muir and Adie, Ltd.
Newton and Co., H. T.
Rollason, Ltd., W. A.
Shackleton, Ltd., W. S.
Skyways, Ltd.
Walter, A. J.
Whittemore (Aeradio), Ltd., A. J.

SALES, ENGINE
Aerocontacts (Sales), Ltd
Aeroservices, Ltd.
Aircraft Spares and Components
Air Engine Services (U.S.-U.K.), Ltd.
Airwork, Ltd.
Aviation Traders, Ltd.
Avionics, Ltd.
Derby Aviation, Ltd.
Dundas, Ltd., R. K.
Eagle Aircraft Services, Ltd.
Ferry Airports, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Muir and Adie, Ltd.
Newton and Co., H. T.
Rollason Engines, Ltd.
Shackleton, Ltd., W. S.
Skyways, Ltd.
Walter, A. J.
Whittemore (Aeradio), Ltd., A. J.

SCREWS.—see A.G.S. Parts

SEALANTS
Aircraft Materials, Ltd.
B. B. Chemical Co., Ltd.
Crane Packing, Ltd.
Fireproof Tanks, Ltd.
Goodyear Tyre and Rubber Co., (Great Britain), Ltd.
Kenilworth Manufacturing Co., Ltd., The
Peradin and Watercraft, Ltd.
Titanine, Ltd.

SEALS.—see Jointing Materials

SEATS, AIRCRAFT
Aerocontacts (Sales), Ltd.
Aeroplastics, Ltd.
Baynes Aircraft Interiors, Ltd
Dart Aircraft, Ltd.
Eagle Aircraft Services, Ltd.
Essex Aero, Ltd.
Field Aircraft Services, Ltd.
Flight Equipment and Engineering, Ltd.
Jablo Plastics Industries, Ltd.
Lancefield Aircraft Components, Ltd.
Latex Upholstery, Ltd.
Rollason, Ltd., W. A.
Rumbold and Co., Ltd., L. A.
Scottish Aviation, Ltd.
Vickers-Armstrongs, Ltd.

SEATS, AIRCRAFT, EJECTION
Ferry Airports, Ltd.
Folland Aircraft, Ltd.
M. L. Aviation Co., Ltd.
Martin-Baker Aircraft Co., Ltd.

SERVICING, AIRFRAME
Air Service Training, Ltd.
Airwork General Trading Co.
Aviation Traders (Engineering), Ltd.
Brooklands Aviation, Ltd.
Eagle Aircraft Services, Ltd.
Essex Aero, Ltd.
Fairey Aviation Co., Ltd., The
Ferry Airports, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Helliwells, Ltd.
Heston Aircraft Co., Ltd., The
Muir and Adie, Ltd.
Rollason, Ltd., W. A.
Samlesbury Engineering, Ltd.
Scottish Aviation, Ltd.
Skyways, Ltd.

SERVICING, ELECTRONIC
Aerocontacts (Sales), Ltd.
Aeronautical Radio Services, Ltd.
Air Trainers, Ltd.
Airwork General Trading Co.
Aviation Traders (Engineering), Ltd.
Avionics, Ltd.
British Communications Corporation, Ltd.
Eagle Aircraft Services, Ltd.
Ferry Airports, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Helliwells, Ltd.
International Aeradio, Ltd.
Measuring Instruments (Pullin), Ltd.
Murphy Radio, Ltd.
Racal Aerotronics, Ltd.
Rollason Aerocessories, Ltd.
Rotax, Ltd.
Saunders-Roe, Ltd.
Scottish Aviation, Ltd.
Wayne Kerr Laboratories, Ltd., The
Whittemore (Aeradio), Ltd., A. J.

SERVICING, ENGINE
Air Engine Services (U.S.-U.K.), Ltd.
Airwork General Trading Co.
Aviation Traders (Engineering), Ltd.
Brooklands Aviation, Ltd.
Derby Aviation, Ltd.
Eagle Aircraft Services, Ltd.
Essex Aero, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Muir and Adie, Ltd.
Rollason Engines, Ltd.
Rover Gas Turbines, Ltd.
Samlesbury Engineering, Ltd.
Scottish Aviation, Ltd.
Skyways, Ltd.
Zwicky, Ltd.

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A. J. W. (Instruments), Ltd.
Airwork General Trading Co.
Aviation Traders (Engineering), Ltd.
Dent and Co. and Johnson, Ltd.
Ferry Airports, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Measuring Instruments (Pullin), Ltd.
Muir and Adie, Ltd.
Rollason, Ltd., W. A.
Samlesbury Engineering, Ltd.
Scottish Aviation, Ltd.
Skyways, Ltd.
Speke Instrument Co.
Wynnstruments, Ltd.

SERVO MECHANISMS
A. J. W. (Instruments), Ltd.
Boulton Paul Aircraft, Ltd.
British Messier, Ltd.
British Thomson-Houston Co., Ltd., The
Brown, Ltd., S. G.
Dowty Equipment, Ltd.
Elliott Brothers (London), Ltd.
Ferranti, Ltd.
Flight Refuelling, Ltd.
Graseby Instruments, Ltd.
M. L. Aviation Co., Ltd.
Newmark, Ltd., Louis
Plessey Group
Pullin and Co., Ltd., R. B.
Reilly Engineering, Ltd.
Smiths Aircraft Instruments, Ltd.
Sperry Gyroscope Co., Ltd.
Short Brothers and Harland, Ltd.
Wilmot Breeden, Ltd.

SHEET METAL WORK.—see Fabrications

SHIMS
Attewell and Sons, Ltd., B.
Hall and Hall, Ltd.
Newton and Co., H. T.
Rollason, Ltd., W. A.
Tufnol, Ltd.

SHOCK ABSORBERS.—see Mountings

SILENCERS
Cementation (Muffelite), Ltd.
Cullum and Co., Ltd., Horace W.
Detuners, Ltd.
Eagle Aircraft Services, Ltd.
Vokes, Ltd.

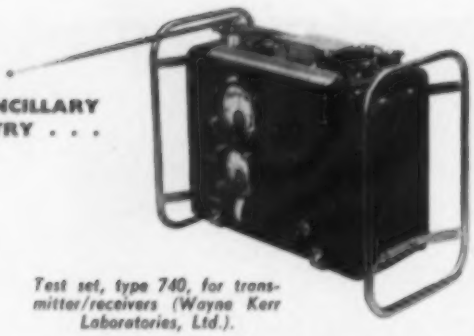
SIMULATORS.—see Training Equipment

SOLDERING EQUIPMENT AND SOLDER
Adcola Products, Ltd.
Aircraft Materials, Ltd.
British Insulated Callender's Cables, Ltd.
Jenolite, Ltd.
Light Soldering Developments, Ltd.
Standard Telephones and Cables, Ltd.
Wolf Electric Tools, Ltd.

SOLENOIDS
Avionics, Ltd.
British Thomson-Houston Co., Ltd., The
Dowty Equipment, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Graseby Instruments, Ltd.
I. V. Pressure Controllers, Ltd.
Newton and Co., H. T.
Plessey Group
Rotax, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

(Continued overleaf)

THE ANCILLARY INDUSTRY . . .



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SOUNDPROOFING MATERIALS
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Cementation (Muffelite), Ltd.
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Detuners, Ltd.
Eagle Aircraft Services, Ltd.
Fairey Aviation Co., Ltd., The
Jablo Plastics Industries, Ltd.
Rumbold and Co., Ltd., L. A.
Whittemore (Aeradio), Ltd., A. J.

SPARES, SUPPLY OF
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Aircraft Spares and Components
Air Engine Services (U.S.-U.K.), Ltd.
Aviation Traders (Engineering), Ltd.
Avionics, Ltd.
Derby Aviation, Ltd.
Dundas, Ltd., R. K.
Eagle Aircraft Services, Ltd.
Eastern Aero Electrical Services, Ltd.
Ferry Airports, Ltd.
Field Aircraft Services, Ltd.
Helicopter Sales, Ltd.
Mollart Engineering Co., Ltd., The
Muir and Adie, Ltd.
Newton and Co., H. T.
Rollason, Ltd., W. A.
Rollason Engines, Ltd.
Rover Gas Turbines, Ltd.
Scottish Aviation, Ltd.
Shackleton, Ltd., W. S.
Stewart Aeronautical Supply Co., Ltd.
Walter, A. J.
Whittemore (Aeradio), Ltd., A. J.

STABILIZERS, AUTOMATIC
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Newmark, Ltd., Louis
Sperry Gyroscope Co., Ltd.

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Aerocontacts (Sales), Ltd.
Atlas Diesel Co., Ltd.
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Lacy-Hulbert and Co., Ltd.
Muir and Adie, Ltd.
Tecalemit, Ltd.

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Fox and Co., Ltd., Samuel
Newton and Co., H. T.
Salter and Co., Ltd., Geo.
Terry and Sons, Ltd., Herbert

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Access Equipment, Ltd.
Aero Controls, Ltd.
Autoset (Production), Ltd.
Chemring, Ltd.
Dart Aircraft, Ltd.
Field Aircraft Services, Ltd.
Heston Aircraft Co., Ltd., The
Reynolds Tube Co., Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame
Tiltman Langley, Ltd.

STANDS, ENGINE, ETC.
Aerocontacts (Sales), Ltd.
Aero Maintenance Equipment, Ltd.
Aeroservices, Ltd.
Autoset (Production), Ltd.
Aviation Traders (Engineering), Ltd.
Chemring, Ltd.
Corner and Co., Ltd., G.
Dart Aircraft, Ltd.
Eagle Aircraft Services, Ltd.
Eccles (Birmingham), Ltd.
Field Aircraft Services, Ltd.
Leytonstone Jig and Tool Co., Ltd.
M. L. Aviation Co., Ltd.
Rollason Engines, Ltd.
Ross, Ltd., S. Grahame
Walter, A. J.

STARTERS
Aerocontacts (Sales), Ltd.
Aero Maintenance Equipment, Ltd.
Aeroservices, Ltd.
Aircraft Spares and Components
British Thomson-Houston Co., Ltd., The
City Electrical Co.
Eagle Aircraft Services, Ltd.
Eastern Aero Electrical Services, Ltd.
Field Aircraft Services, Ltd.
I. V. Pressure Controllers, Ltd.
Lincoln Electric Co., Ltd.
Murex Welding Processes, Ltd.
Newton and Co., H. T.
Partridge, Wilson and Co., Ltd.
Petbow, Ltd.
Peto and Radford, Ltd.
Plessey Group
Rotax, Ltd.
Rover Gas Turbines, Ltd.
Salford Electrical Instruments, Ltd.
Scintilla, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Vernons Industries, Ltd.
Westinghouse Brake and Signal Co., Ltd.

STEEL.—see Ferrous Alloys

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Air Survey Co., Ltd.
Derby Aviation, Ltd.
Fairey Aviation Co., Ltd., The
Flight Refuelling, Ltd.
Hunting Aerosurveys, Ltd.
Meridian Airmaps, Ltd.
Skyways, Ltd.

SWITCHES, AUTOMATIC AND SPECIAL-PURPOSE
British Messier, Ltd.
British Thomson-Houston Co., Ltd., The
Cathodeon, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Graseby Instruments, Ltd.
Graviner Manufacturing Co., Ltd.
Negretti and Zambra, Ltd.
Newton and Co., H. T.
Rotax, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Teddington Aircraft Controls, Ltd.
Thermal Control Co., Ltd.
Venner, Ltd.
Western Manufacturing (Reading), Ltd.
Wynn and Co. (Aircraft), Ltd., E. D.

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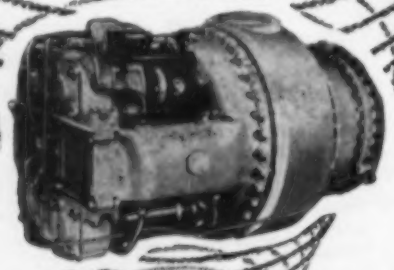

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Avimo of Taunton
Chamberlain Industries, Ltd.
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Eagle Aircraft Services, Ltd.
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Goodmans Industries, Ltd.
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Heston Aircraft Co., Ltd., The
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Hymatic Engineering Co., Ltd.
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Newton and Co., H. T.
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Field Aircraft Services, Ltd.
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Rollason Aerocessories, Ltd.
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Jessop and Sons, Ltd., William
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Samlesbury Engineering, Ltd.
Scottish Aviation, Ltd.
Thompson (Engineers), Ltd., Raymond F.
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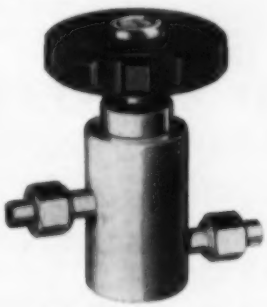

Rollason sensitive control valve for test gear, etc.

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British Thomson-Houston Co., Ltd., The
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Lincoln Electric Co., Ltd.
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Petbow, Ltd.
Sanders (Electronics), Ltd., W. H.
Sciaky Electric Welding Machines, Ltd.

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Lincoln Electric Co., Ltd.

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Field Aircraft Services, Ltd.
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Palmer Tyre, Ltd., The
Rollason, Ltd., W. A.
Walter, A. J.

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Rotax, Ltd.
Stewart Aeronautical Supply Co. Ltd.
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Ross, Ltd., S. Grahame

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Access Equipment, Ltd., Braemar Avenue, Neasden, London, N.W.10. T: Gladstone 8283/4. TA: Accessequip, Harles, London.

Accles and Pollock, Ltd., Oldbury, Birmingham. T: Broadwell 1500. TA: Accles, Phone Oldham.

Acton Bolt, Ltd., 26 Chase Road, London, N.W.10. T: Elgar 5775. TA: Pinethreads, Harles, London.

Adcola Products, Ltd., Gauden Road, Clapham, S.W.4. T: Macaulay 4272.

Aerocontacts (Sales), Ltd., Gatwick Airport, Horley, Surrey. T: Horley 1510. TA: Aerocon, Horley.

Aero Controls, Ltd., Industrial Estate, Weedon Road, Northampton. T: Northampton 33131.

Aero Maintenance Equipment, Ltd., 100a Clapham Park Road, London, S.W.4. T: Macaulay 2477-8. TA: Amble, London, S.W.4.

Aeronautical Radio Services, Ltd., Doman Road, Camberley, Surrey. T: Camberley 2341/2/3.

Aeroplastics, Ltd., Earl Haig Road, Hillington, Glasgow, S.W.2. T: Halfway 1683. TA: Aeroplastic, Glasgow.

Aero Research, Ltd., Duxford, Cambridge. T: Sawston 187. TA: Aerodux, Cambridge.

Aeroservices, Ltd., Croydon Airport, Croydon, Surrey. T: Croydon 9373. TA: Aeroserv, Croydon.

Aircraft Engineering and Jigs, Ltd., Wren Works, James Street, Chadderton, nr., Oldham, Lancs. T: Main 5691. TA: Doddwren.

Aircraft Materials, Ltd., Midland Road, London, N.W.1. T: Euston 6151. TA: Airworthy, Norwest, London.

Aircraft Spares and Components, 85 Shaftesbury Avenue, London, W.1. T: Gerrard 0575.

Air Engine Services (U.S.-U.K.), Ltd., Blindley Heath, Lingfield, Surrey. T: Lingfield 2646. TA: Pratwit, Blindley Heath.

Airflow Streamlines, Ltd., Main Road, Far Cotton, Northampton. T: Northampton 32472-3-4. TA: Airflow, Northampton.

Airscrew Co. and Jicwood, Ltd., The, Weybridge, Surrey. T: Weybridge 1600/4. TA: Airscrew, Weybridge.

Air Service Training, Ltd., Hamble, Southampton, Hants. T: Hamble 3001 (9 lines). TA: Training, Hamble.

Air Survey Co., Ltd., 24 Bruton Street, London, W.1. T: Mayfair 8791. TA: Airimap, London.

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Godfrey and Partners, Ltd., Sir George, Hampton Road West, Hanworth, Middx. T: Feltham 3291-7. TA: Godfrepart, London.

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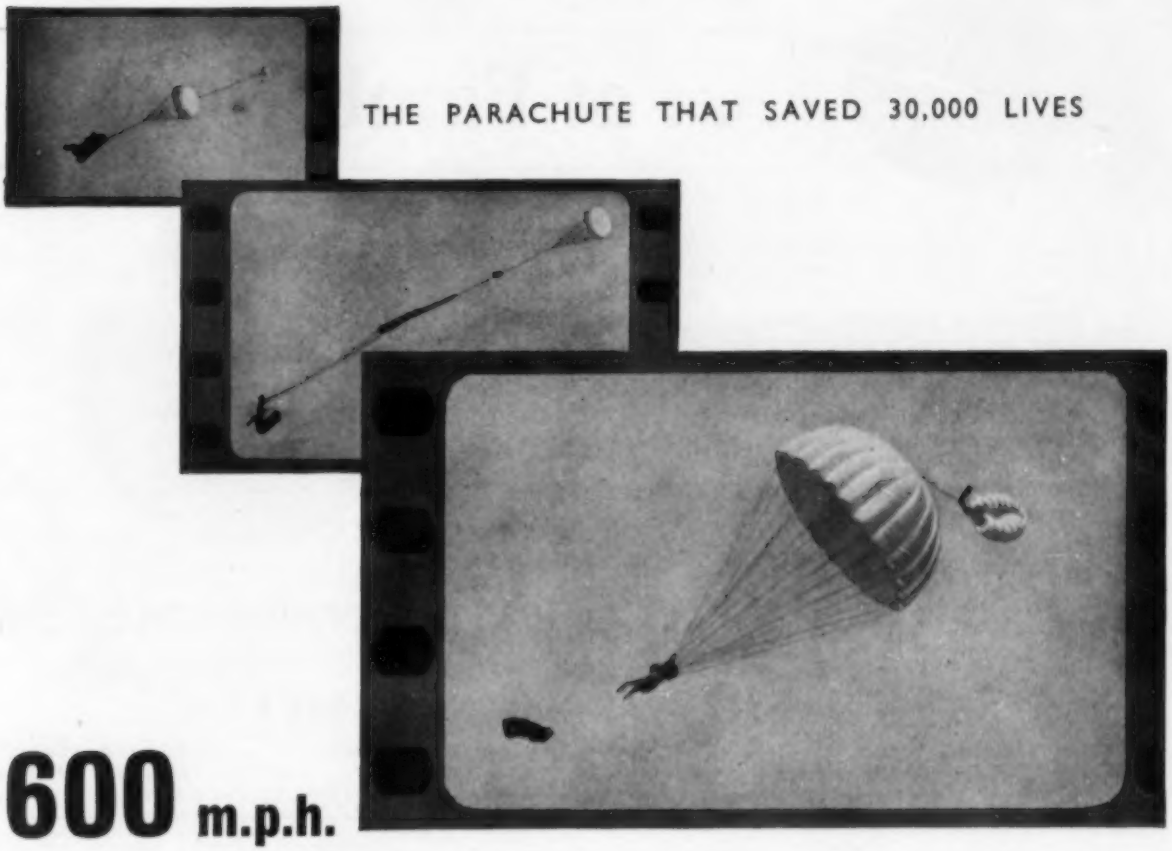

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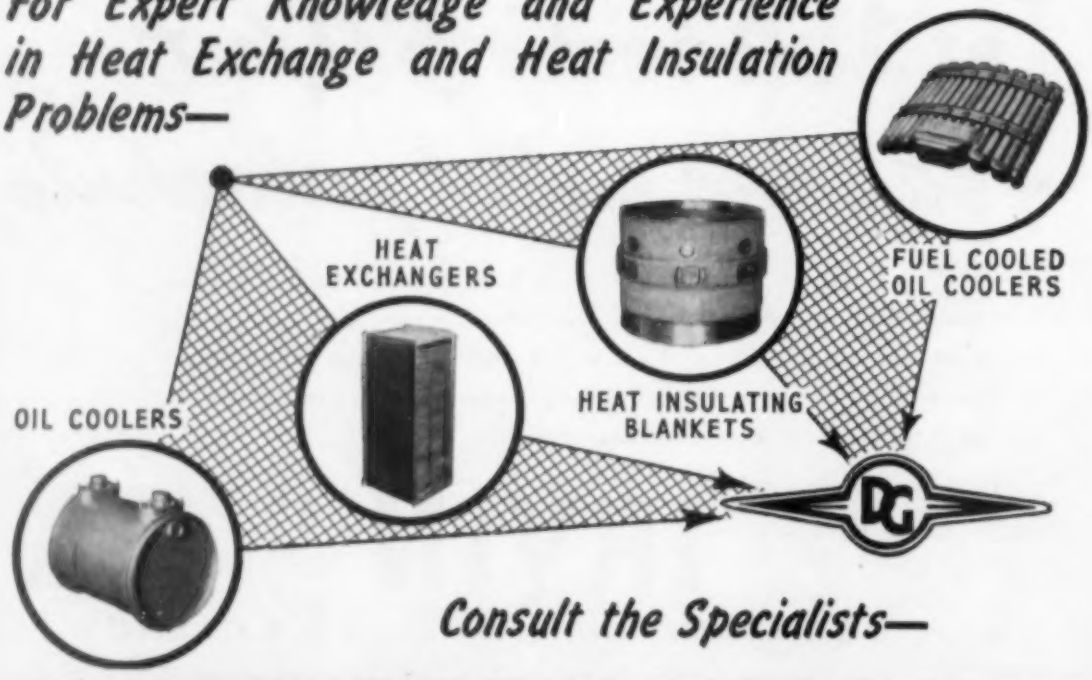

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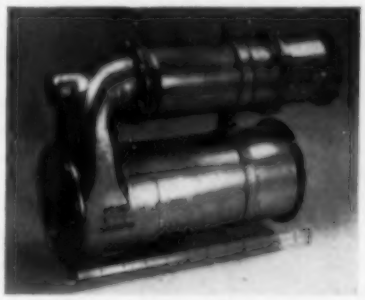

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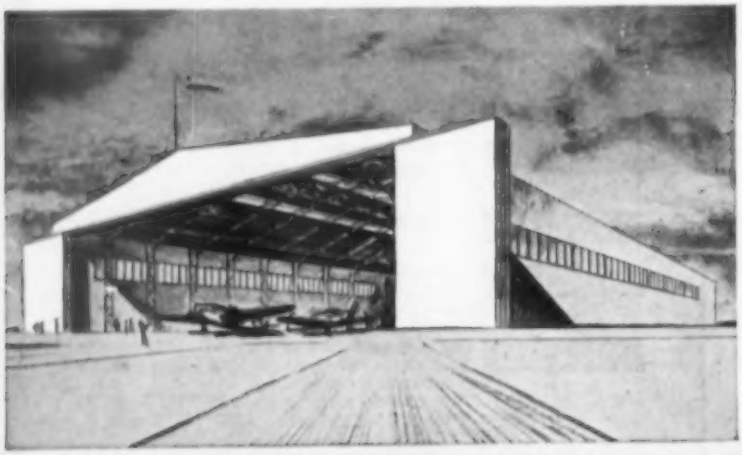

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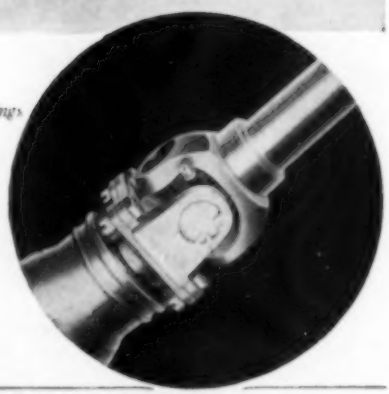

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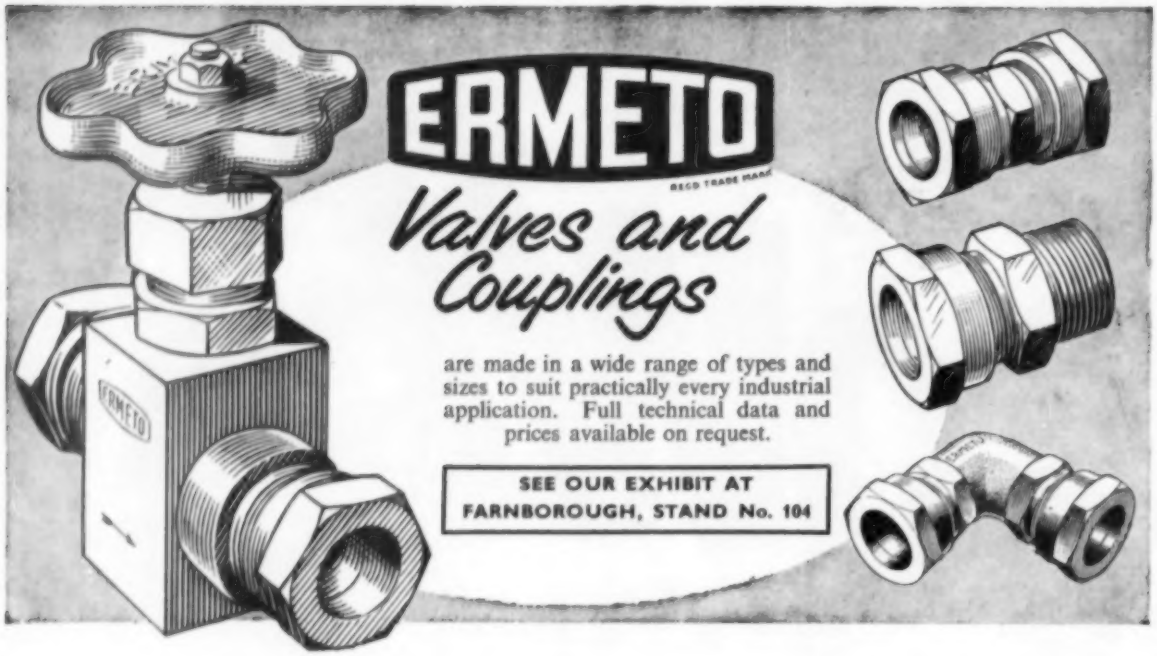
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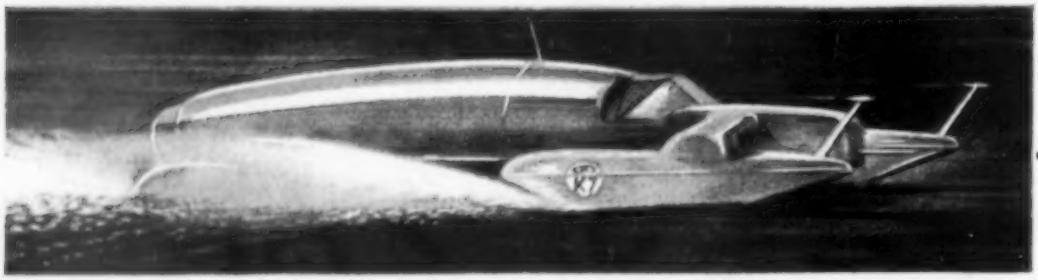

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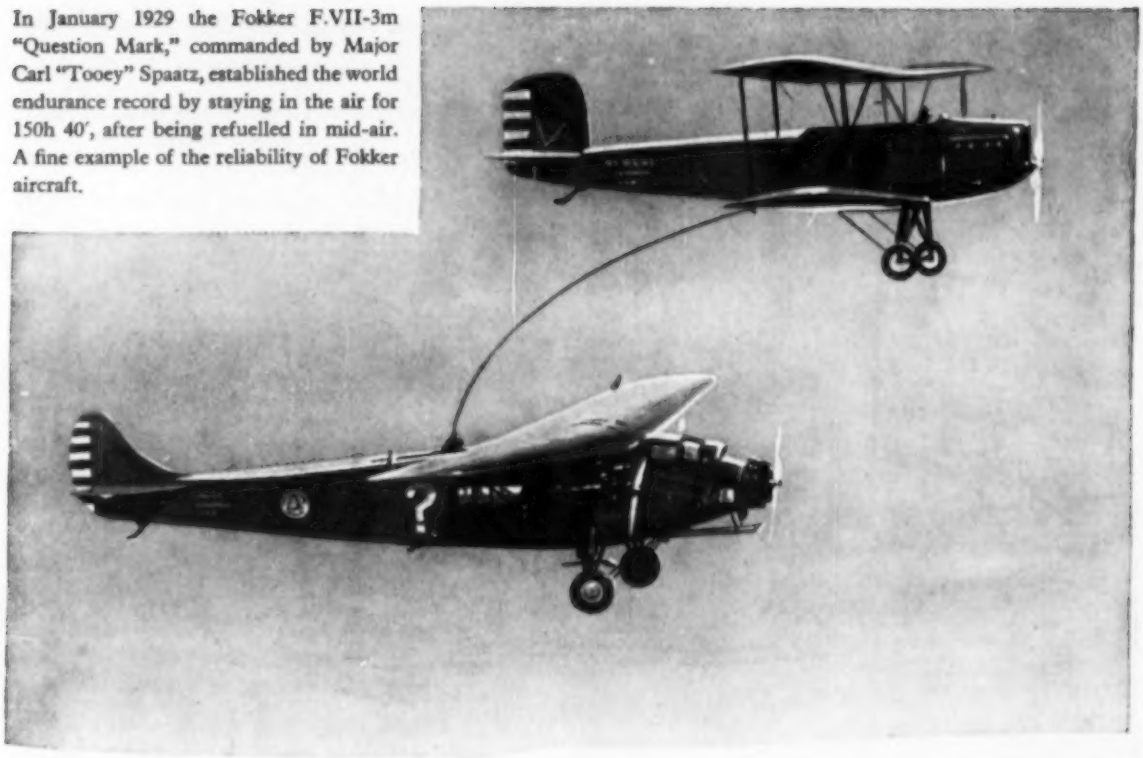

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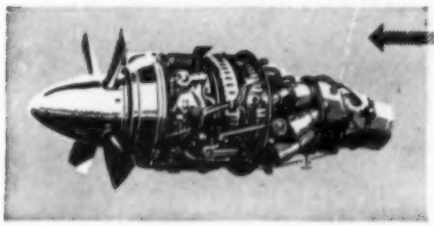

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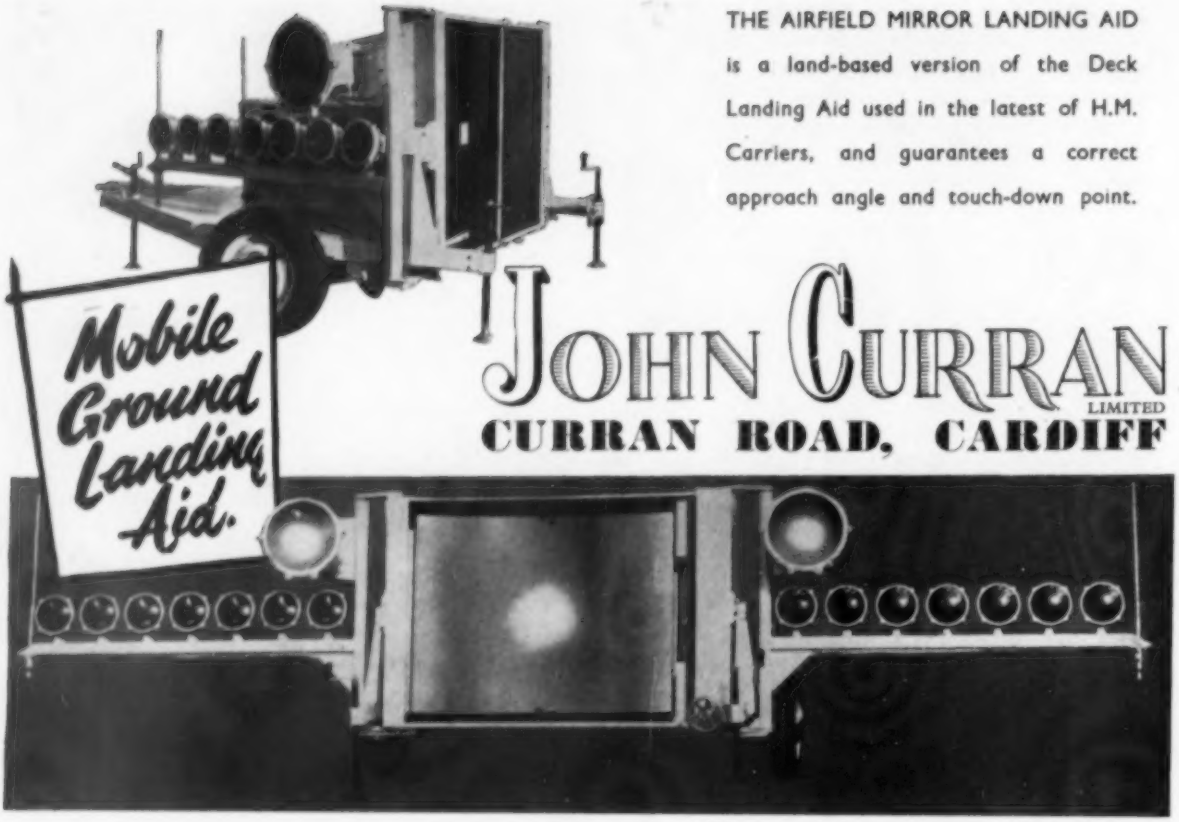

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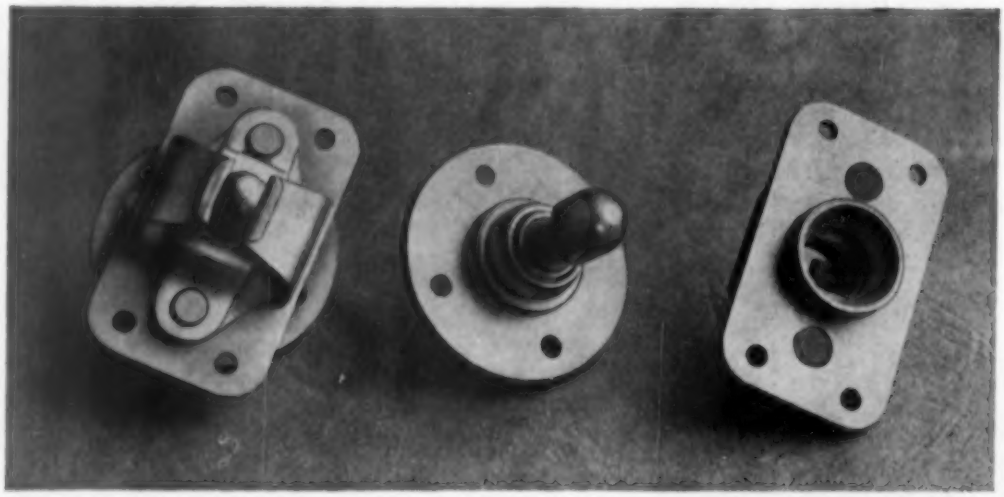

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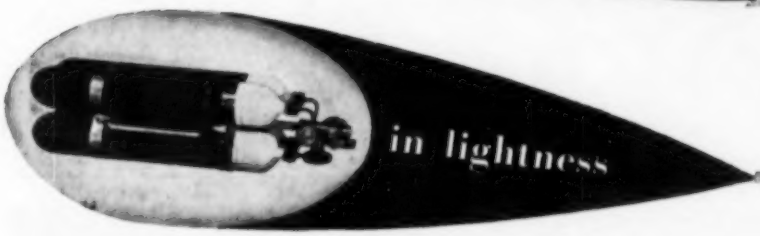

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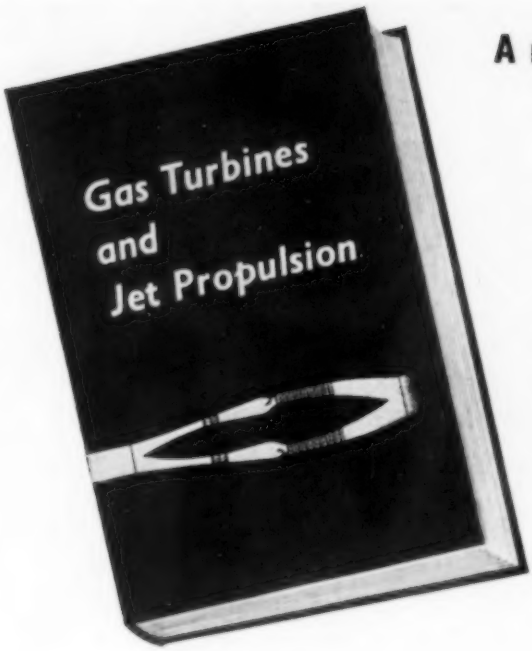

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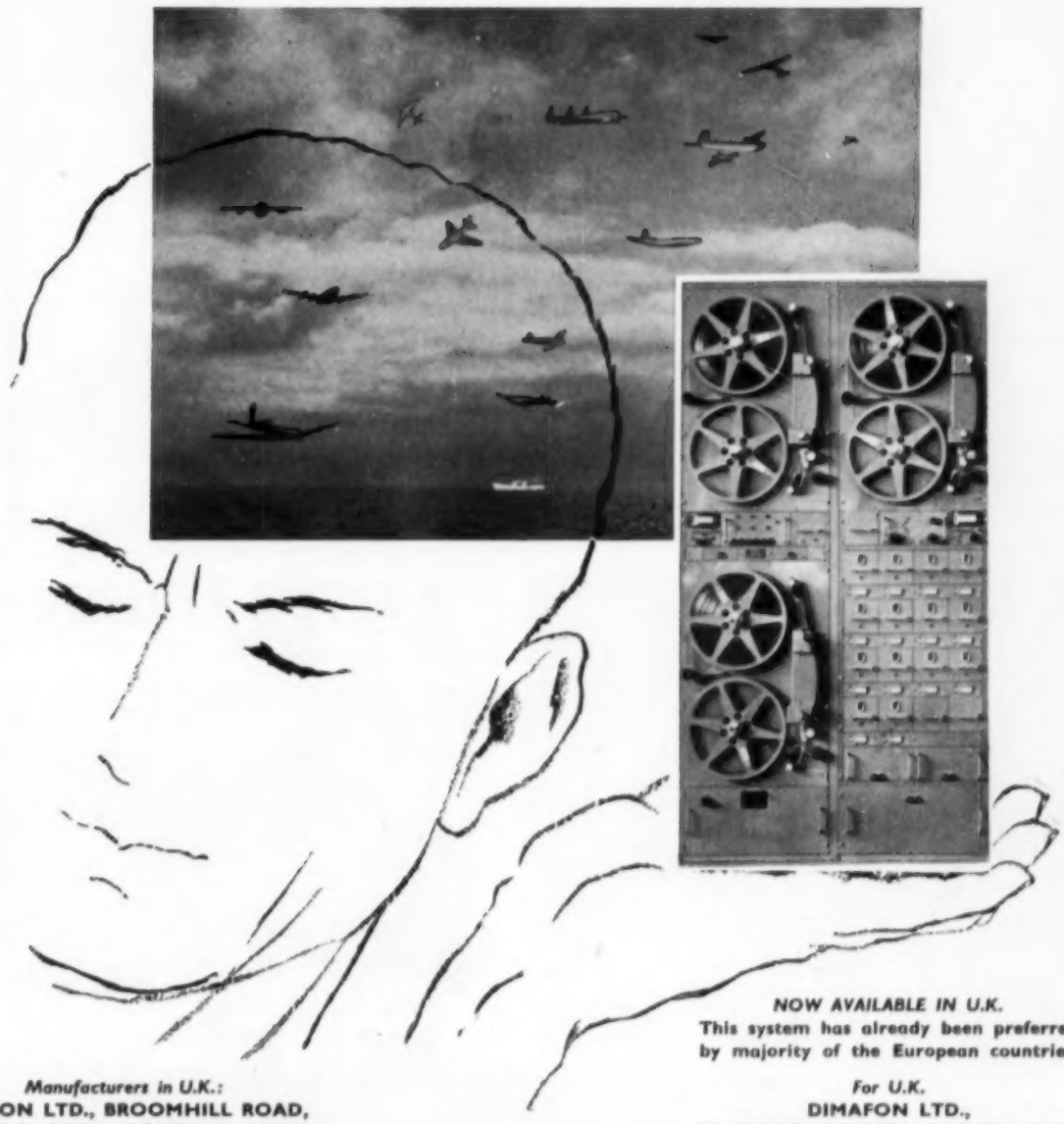

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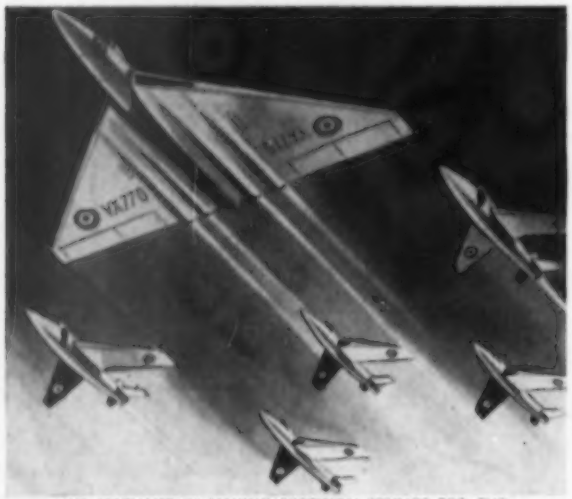

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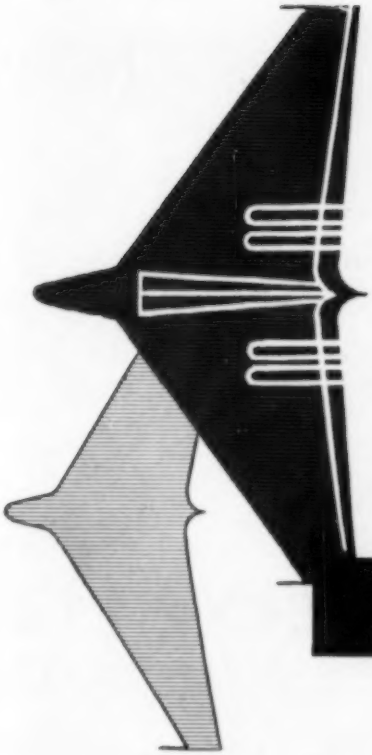

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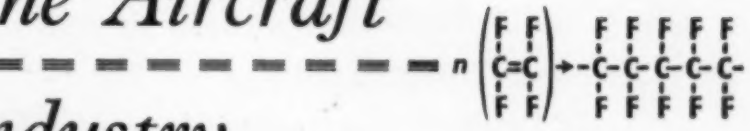

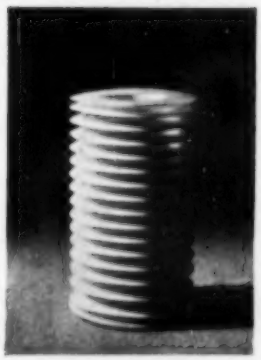

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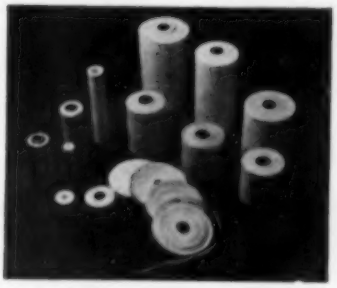

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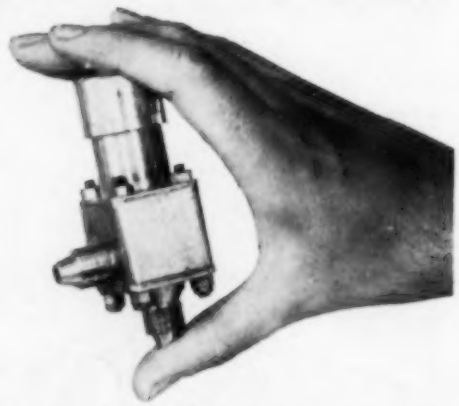

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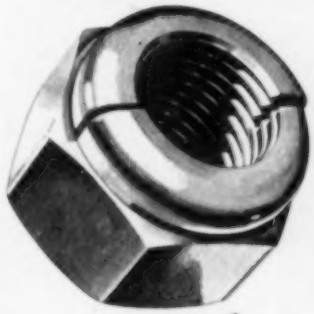

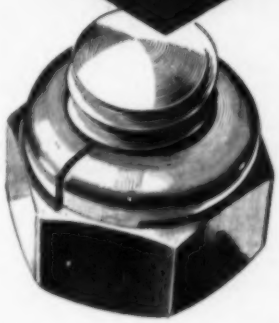

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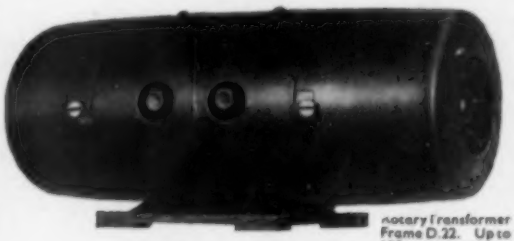

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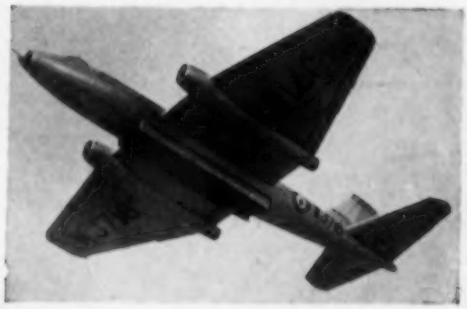

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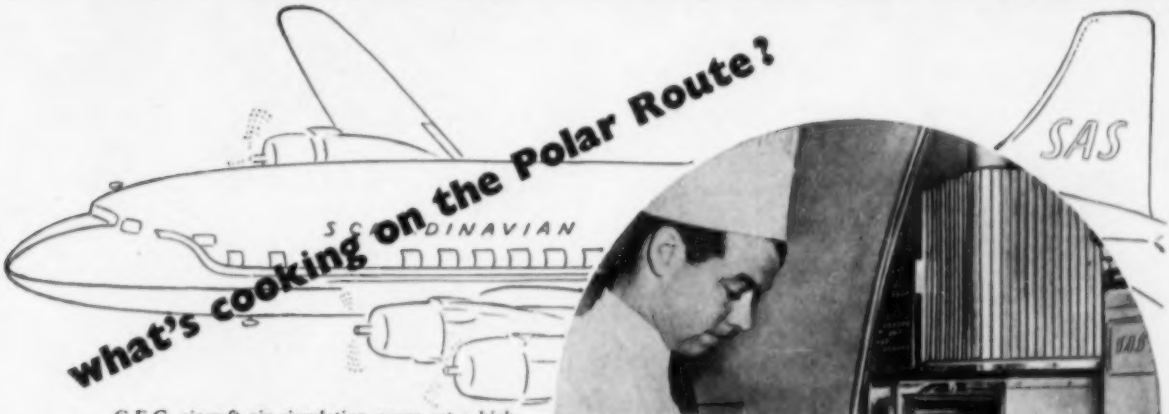

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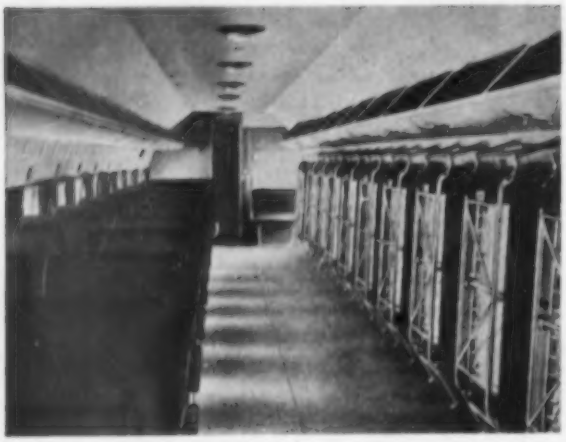

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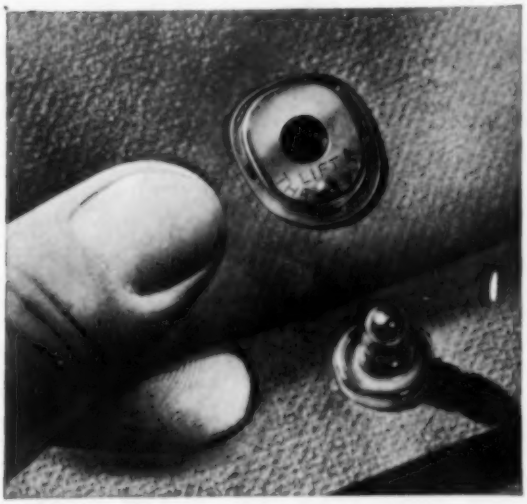

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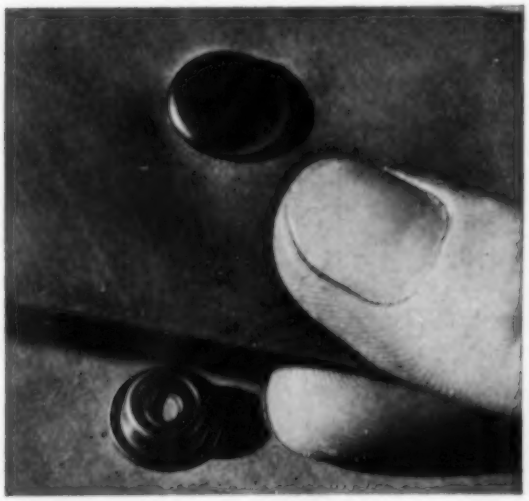

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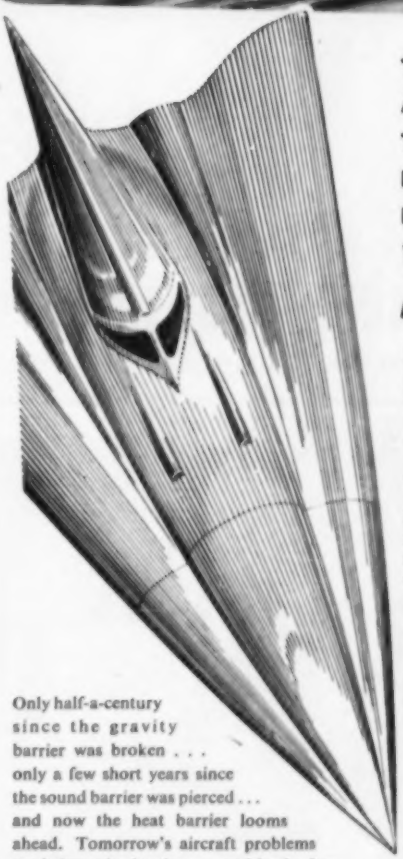

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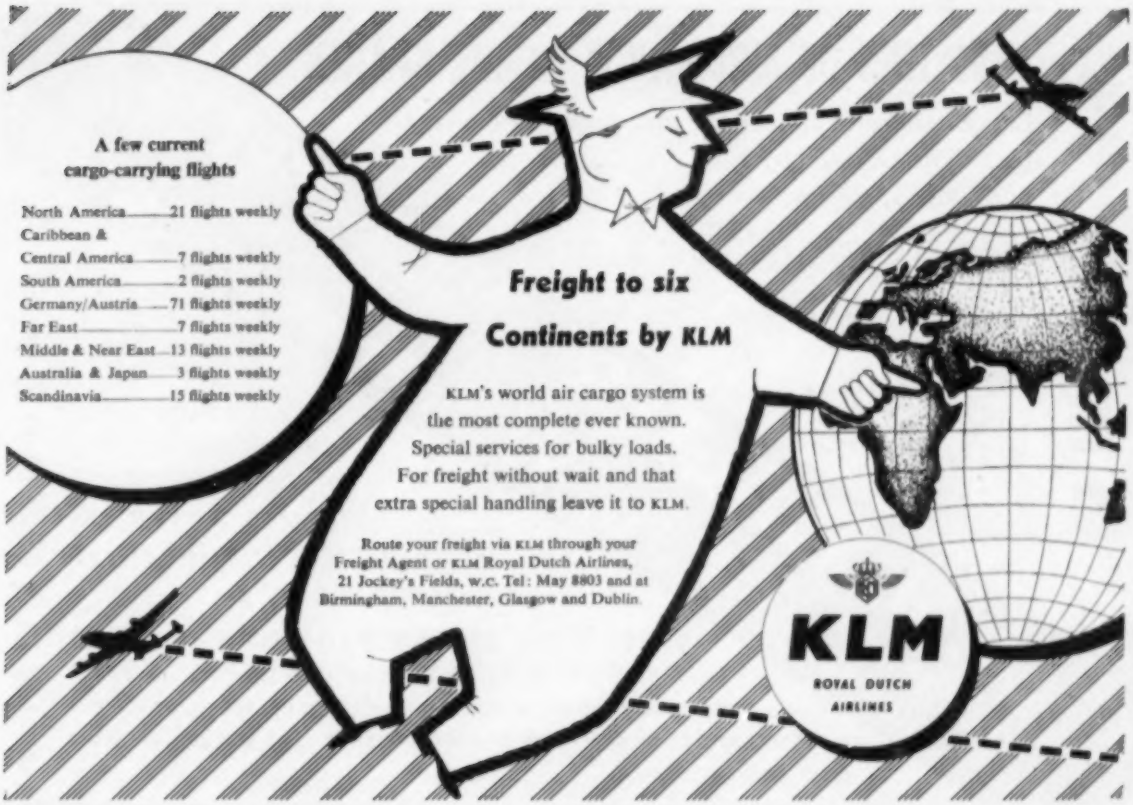
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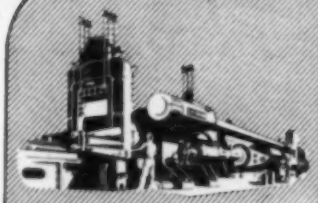
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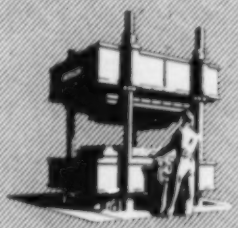
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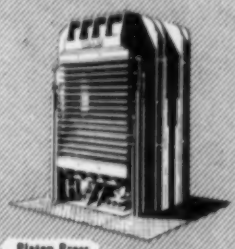
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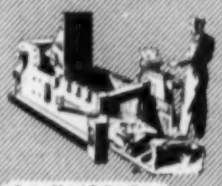
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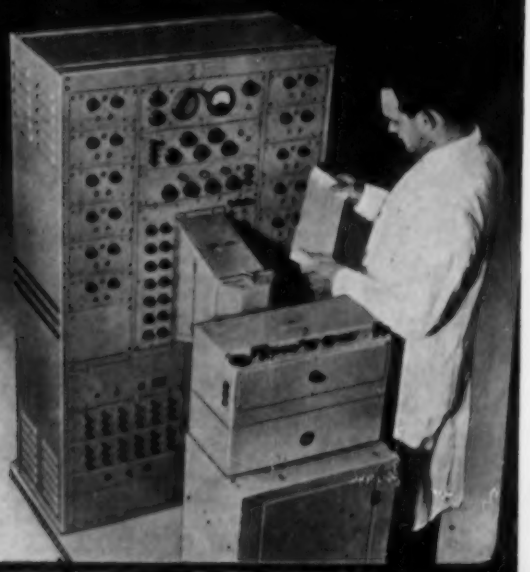

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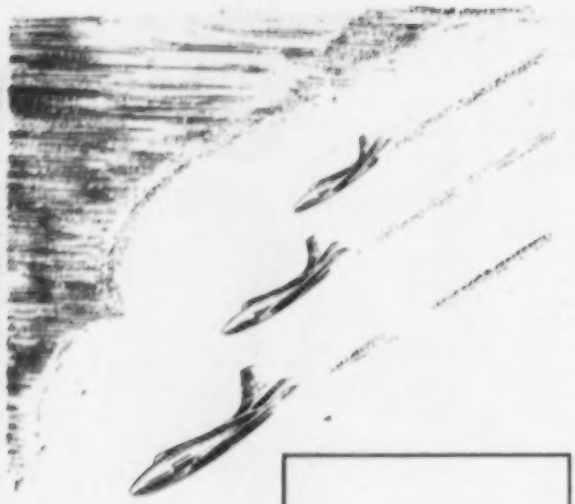

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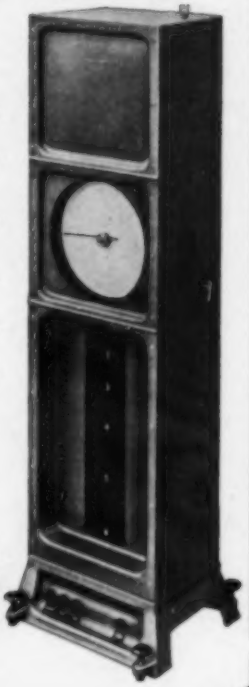

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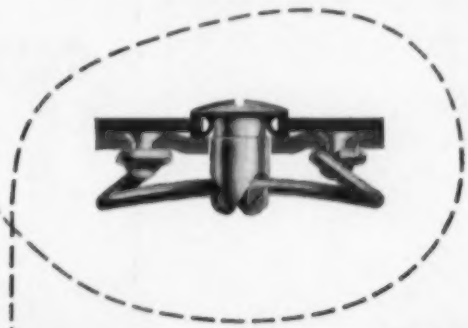

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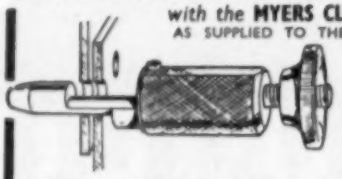

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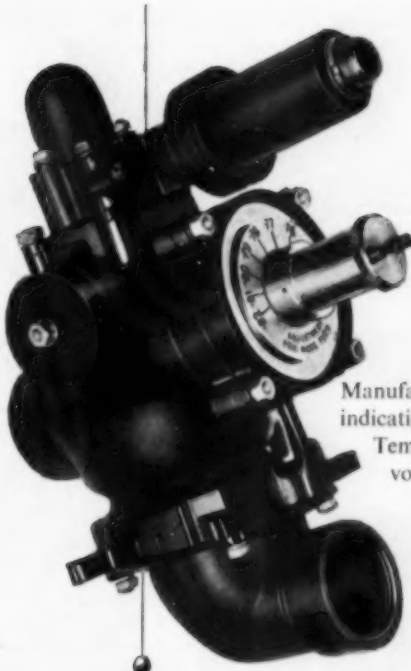

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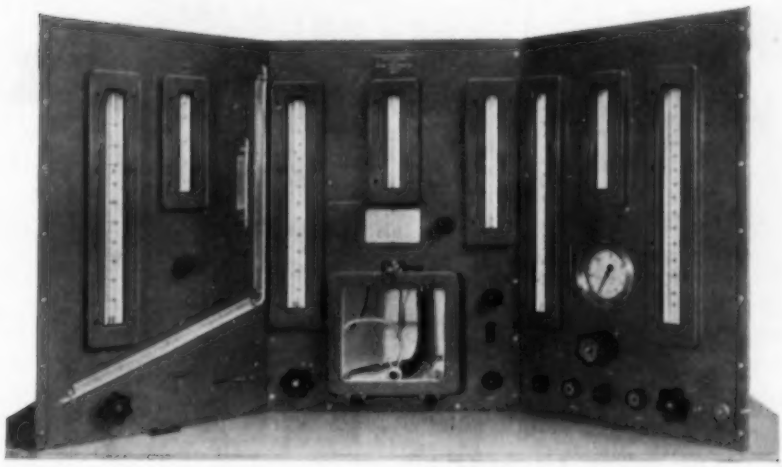

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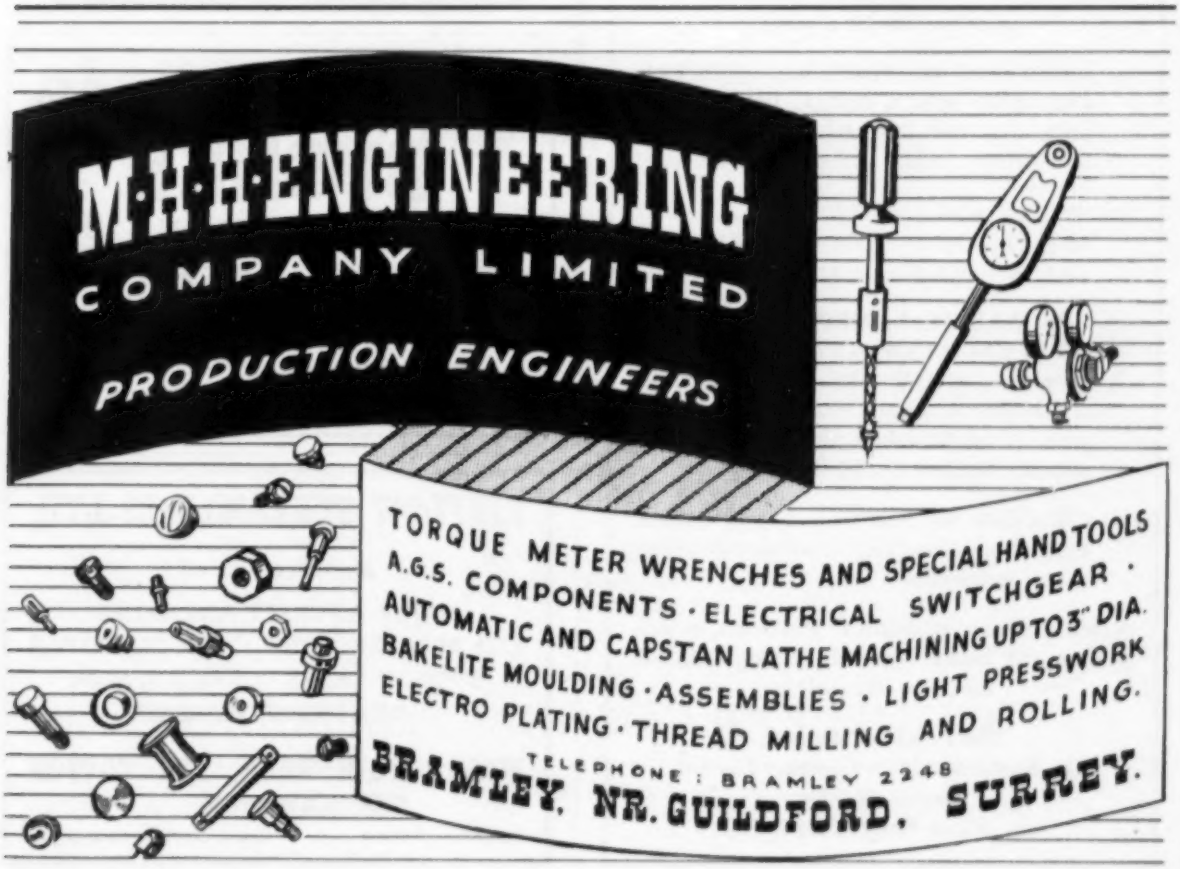
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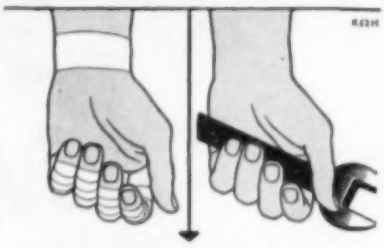

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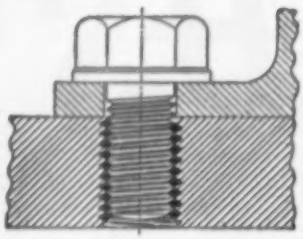

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FURTHER information, application forms and particulars of general conditions may be obtained on request from:
THE HIGH COMMISSIONER FOR NEW ZEALAND,
415 Strand,
London, W.C.2.
quoting reference No. A.3/47/52 and mentioning this paper.

COMPLETED applications (in duplicate) accompanied by copies only (also in duplicate) of two recent testimonials should be lodged not later than September 30th, 1955. [4182

MINISTRY OF SUPPLY requires Engineers (Aeronautical, Mechanical, Electrical) at Experimental Establishments mainly near Farnborough, Hants., Amesbury, Wilts., Sevenoaks, Kent, Bedford, Aylesbury, Bucks., and at London Headquarters. Duties comprise research and development work on aircraft and aircraft equipment, armaments, gas turbines, tracked and wheeled vehicles. Qualifications: 1st or 2nd class Hons. degree or equivalent. Some research or development experience may be an advantage. Appointments initially in Scientific Officer grade with starting salary in range £492 10s.-£885 (London); £467 10s.-£845 (provinces) (superannuable), according to age and research or development experience. Women's salary subject to equal pay scheme. Application forms from M.L.N.S., Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting C627/5A. Closing date September 17th, 1955. [4163

PHYSICISTS and Mechanical Engineers required by Ministry of Supply, Royal Aircraft Establishment, Farnborough, Hants., for research and development mainly concerning engineering, instrumentation and problems of parachute development and application, vulnerability of aircraft, refrigeration and air conditioning. Qualifications: 1st or 2nd class Hons. degree or equiv. in Physics or Mech. Engineering. Some understanding of Aerodynamics an advantage. Appointments according to age, post graduate experience, etc. Scientific Officer or Senior Scientific Officer. Salary, S.O. (min. 21) £467 10s.- £845; S.S.O. (min. 26) £970-£1,125 (superannuable). Equal pay scheme. Application forms from M.L.N.S., Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting A304/5A. Closing date September 17th, 1955. [4177

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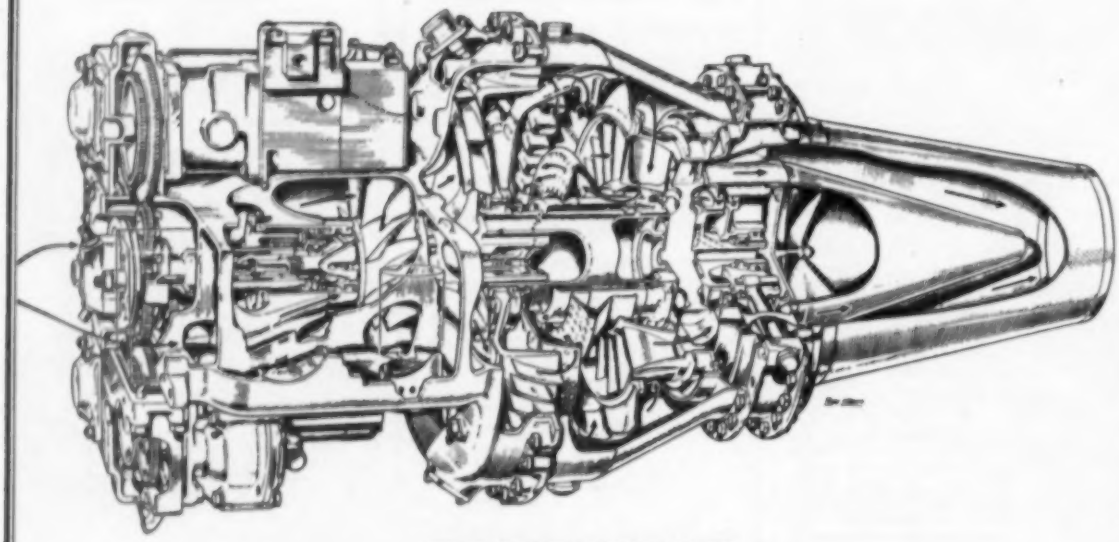

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INDEX TO ADVERTISERS

	Page
Abbey Panel and Sheet Metal Co., Ltd.	56
Aero Controls, Ltd.	186
Aero Research, Ltd.	20
Aeroservices, Ltd.	220
Aircraft Engineering and Jigs, Ltd.	72
Aircraft Materials, Ltd.	40
Air Engine Services (U.S.-U.K.), Ltd.	219
Airflow Streamlines, Ltd.	216
Air Service Training, Ltd.	7
Air Trainers, Ltd.	188
Airwork, Ltd.	78
Alvis, Ltd.	12o
Amalgamated Wireless (Australasia), Ltd.	60
Armstrong Whitworth Aircraft, Ltd., Sir W. G.	227
Assmann GMBH, Wolfgang	189
Aston and Co., Ltd., F. S.	196
Attewell and Sons, Ltd., B.	220
Auster Aircraft, Ltd.	173
Auto-Diesels, Ltd.	45
Automotive Products Co., Ltd.	113
Aviation Developments, Ltd.	205
Aviation Traders, Ltd.	123
Avica Equipment, Ltd.	186
Avionics, Ltd.	220
Bakelite, Ltd.	144
Bardolph and Partners, Ltd., J. F.	212
Baxters (Bolts, Screws and Rivets), Ltd.	176
B.B. Chemical Co., Ltd.	18
Bellman Hangars, Ltd.	172
Blackburn and General Aircraft, Ltd.	85, 166, 222
Bloctube Controls, Ltd.	200
Blundell Rules, Ltd.	212
Boulton Paul Aircraft, Ltd.	119
Bowden (Engineers), Ltd.	202
Brand and Co., Ltd., R. A.	15
B.R.D. Co., Ltd.	17
Briggs Motor Bodies, Ltd.	145
Bristol Aeroplane Co., Ltd., The	Cover iv, 216
British Artid Plastics, Ltd.	163
British Aviation Insurance Co., Ltd., The	208
British Communication Corporation, Ltd.	174
British Ermeto Corporation, Ltd.	180
British European Airways	142
British Manf. and Research Co., Ltd.	44
British Oxygen Co., Ltd.	Cover iii
British Petroleum Co., Ltd., The	152
British Thomson-Houston Co., Ltd., The	206
British Timken, Ltd.	Cover ii
Brooklands Aviation, Ltd.	225
Brown and Co., Ltd., E. G.	176
Brown Corporation (Sales), Ltd., David, The	37, 156
Bryans Aeroquipment, Ltd.	215
Burnley Aircraft Products, Ltd.	77
Campbell (Engineers) Ltd., J. R.	192
Canadair, Ltd.	153
Carlisle and Co., Ltd., C. G.	208
Carr Fastener Co., Ltd.	201
Cellon, Ltd.	149
Chelton (Electrostatics), Ltd.	178
Chloride Batteries, Ltd.	6
City Electrical Co.	214
Coley and Son (Hounslow), Ltd., R. J.	200
Collingridge, Ltd., B. F.	214
Computing Devices of Canada, Ltd.	81
Coopers Mechanical Joints, Ltd.	196
Corner and Co., Ltd., G.	199
Cossor Group of Companies, The	2, 3
Counting Instruments, Ltd.	204
Cox and Co., John P.	204
Cox and Son, Ltd., John	192
Crane Packing, Ltd.	191
Cross Manufacturing Co. (1938), Ltd.	220
Curran Ltd., John	182
Decca Navigator Co., Ltd., The	106
De Havilland Aircraft of Canada, Ltd., The	5
De Havilland Engine Co., Ltd., The	224
De Havilland Enterprises, The	115-118
Delaney Gallay, Ltd.	170
Dent and Co. and Johnson Ltd.	214
Derby Aviation Ltd.	218
Desoutter, Ltd.	122
Docker Brothers	29
Douglas Equipment, Ltd.	76
Dowty Equipment, Ltd.	90, 225
Dragonair, Ltd.	206
Dunlop Rubber Co., Ltd.	127-130, 227
Dzus Fasteners, Europe, Ltd.	209
Eagle Aircraft Services, Ltd.	217
Eastern Aero Electrical Services, Ltd.	210
Ekco Electronics, Ltd.	167
Elliott Brothers (London) Ltd.	66, 67
Elliott Equipment Ltd.	70
E.M.O. Instrumentation, Ltd.	194
Engineering Products, Ltd.	216
English Electric Co., Ltd., The	42, 43, 108, 109
E.N.V. Engineering Co., Ltd.	4
E.R.S., Ltd.	190
Esso Petroleum Co., Ltd.	99
Export Packing Service, Ltd.	165
Fairey Aviation Co., Ltd., The	100-105
Feltham and Son, Ltd., Walter H.	220
Ferranti, Ltd.	22, 41, 225
Fibreglass, Ltd.	159
Field Aircraft Services, Ltd.	98, 219
Fielding and Platt, Ltd.	207
Fireproof Tanks, Ltd.	194
Firth and John Brown, Ltd., Thos.	25
Firth-Derihon Stampings, Ltd., The	38
Flight Equipment and Engineering, Ltd.	200
Flight Refuelling, Ltd.	158
Fokker	181
Folland Aircraft, Ltd.	141
Frankenstein and Sons (Manchester) Ltd., P.	10
Garringtons, Ltd.	162
General Electric Co., Ltd., The	199
Gloster Aircraft Co., Ltd.	226
Godfrey and Partners, Ltd., Sir George	1
Goodmans Industries, Ltd.	71
Goodyear Tyre and Rubber Co. (Great Britain), Ltd., The	157
G.Q. Parachute Co., Ltd.	62
Graseby Instruments, Ltd.	73
Graviner Manufacturing Co., Ltd., The	65
Guest, Keen and Nettlefolds (Midlands), Ltd.	197
Habershon and Sons, Ltd., J. J.	178
Hale, Hamilton and Co., Ltd.	196
Hall and Sons (Bristol and London), Ltd., John	54
Handley Page, Ltd.	83
Hardy Spicer, Ltd.	174
Hawker Aircraft, Ltd.	225
Hawker Siddeley Group	133-140
Headquarter and General Supplies, Ltd.	220
Hepworth and Grandage (Yeadon), Ltd.	92
Heston Aircraft Co., Ltd.	223
High Duty Alloys, Ltd.	150
High Pressure Components, Ltd.	69
Hindustan Aircraft, Ltd.	84
H.M.I. Engineering, Ltd.	32
Hobson, Ltd., H. M.	39, 221
Hughes Lathbury, Ltd.	212
Hunting Percival Aircraft, Ltd.	107
Hymatic Engineering Co., Ltd., The	11
Ilford, Ltd.	36
Iliffe and Sons, Ltd.	187
Imperial Chemical Industries, Ltd.	148
Insulators, Ltd.	146
Integral, Ltd.	184
Irving Air Chute of Great Britain, Ltd.	169
I.V. Pressure Controllers, Ltd.	63
Jenks Brothers, Ltd.	206
Kautex, Ltd.	210
Kidde Co., Ltd., Walter, The	183
K.L.M. Royal Dutch Airlines	203
Latex Upholstery, Ltd.	214
Laycock Engineering, Ltd.	51
Lewis, Ltd., D.	218
Lucas (Gas Turbine Equipment), Ltd., Joseph	120, 227
Lutterworth Press	202
Mallock-Armstrong Co., The	228
Marconi's Wireless Telegraph Co., Ltd.	59, 61
Marshall's Flying School, Ltd.	220, 227
Marston Excelsior, Ltd.	205
Martin-Baker Aircraft, Ltd.	97
McMichael Radio, Ltd.	213
M.H.H. Engineering Co., Ltd.	215
Miles, Ltd., F. G.	58
Mills, Ltd., William	74
Mining and Chemical Products, Ltd.	46
M. L. Aviation Co., Ltd.	188, 223
Modern Industrial Finishes, Ltd.	211
Mollart Engineering Co., Ltd.	198
Mullard, Ltd.	164
Munro, Ltd., R. W.	208
Murex Welding Processes, Ltd.	48
Napier and Son, Ltd., D.	88, 89
National Institute of Engineering	218
Negretti and Zambra, Ltd.	213
Newmark, Ltd., Louis	192
Newton and Co., Ltd., L. H.	52
Newton Brothers (Derby), Ltd.	198
Normalair, Ltd.	27
Northern Aluminium Co., Ltd.	125
Oddie, Bradbury and Cull, Ltd.	182
Opperman, Ltd., S. E.	175
Orenda Engines, Ltd.	147
Palmer Tyre, Ltd., The	193
Park, Ltd., R. and J.	216
Paul, Ltd., W. H.	14
Percival Aircraft, Ltd., Edgar	223
Peto and Radford	9
Plessey Co., Ltd., The	124
Power Jacks, Ltd.	34
Powis and Sons, Ltd., David	198
Precision Rubbers, Ltd.	195
Pullin and Co., Ltd., J. R.	203
Pulsometer Engineering Co., Ltd.	79
Pye, Ltd.	155
Pyrene Co., Ltd., The	177
Ransome and Marles Bearing Co., Ltd.	24
Ratcliffe (Rochdale), Ltd., F. S.	190
Redifon, Ltd.	160
Reid and Sigrist, Ltd.	12
Reynolds Tube Co., Ltd.	19
R.F.D. Co., Ltd.	112
Rists Wire and Cables, Ltd.	184
Robinson and Co. (Gillingham), Ltd., L.	26
Roe and Co., Ltd., A. V.	Cover i
Roe, Canada, Ltd., A. V.	143
Rollet and Co., Ltd., H.	195
Rotax, Ltd.	121
Rotol, Ltd.	161
Royal New Zealand Air Force	225
Rozalex, Ltd.	218
Rubery Owen and Co., Ltd.	68
Salter and Co., Ltd., George	50
Samlesbury Engineering, Ltd.	180
Sandwell Casting Co., The	194
Sangamo Weston, Ltd.	170
Sankey and Sons, Ltd., Joseph	110
Saunders-Roe, Ltd.	95, 151
Saunders Valve Co., Ltd.	75
Scottish Aviation, Ltd.	131
Self-Priming Pump and Engineering Co., Ltd.	49
Shell-Mex and B.P., Ltd.	114
Short Brothers and Harland, Ltd.	55
Siebe Gorman and Co., Ltd.	210
Siegrist-Orel, Ltd.	202
Silent Gliss, Ltd.	190
Simmonds Aerocessories, Ltd.	16
Skyhi, Ltd.	212
Smith-Clayton Forge, Ltd.	35
Smiths Aircraft Instruments, Ltd.	168
Southern Instruments, Ltd.	207
Sperry Gyroscope Co., Ltd.	93
Staines and Partners, Ltd., J. R.	220
Standard Telephones and Cables, Ltd.	57
Steel Stampings, Ltd.	214
Stewart Aeronautical Supply Co., Ltd.	21
Stone and Co. (Charlton), Ltd., J.	47
Surridge's Patents, Ltd.	30
Teddington Controls, Ltd.	53
Teleflex Products, Ltd.	185
Terry and Sons, Ltd., Herbert	82
Thermal Control Co., Ltd.	80
Thompson Brothers (Bilston), Ltd.	13
Thorn Electrical Industries, Ltd.	96
T.I. Aluminium, Ltd.	23
Titanine, Ltd.	64
Triplex Safety Glass Co., Ltd.	172
Tucker Eyelet Co., Ltd., Geo.	86
Tungum Co., Ltd., The	211
Uhlhorn Brothers, Ltd.	214
Ultra Electric, Ltd.	132
Valay Industries, Ltd.	33
Vernons Industries, Ltd.	179
Vickers-Armstrongs, Ltd.	87, 225, 227
Vokes, Ltd.	201
Vosper, Ltd.	209
V.P. Sheet Metal, Ltd.	28
Walker and Co., Ltd., James	171
Walter, Ltd., A. J.	204
Wellworthy, Ltd.	154
Welsh Metal Industries, Ltd.	8
West and Partners, Ltd., A.	197
Western Manufacturing (Reading), Ltd.	111
Westland Aircraft, Ltd.	94
Wiggin and Co., Ltd., Henry	91
Zwicky, Ltd.	31

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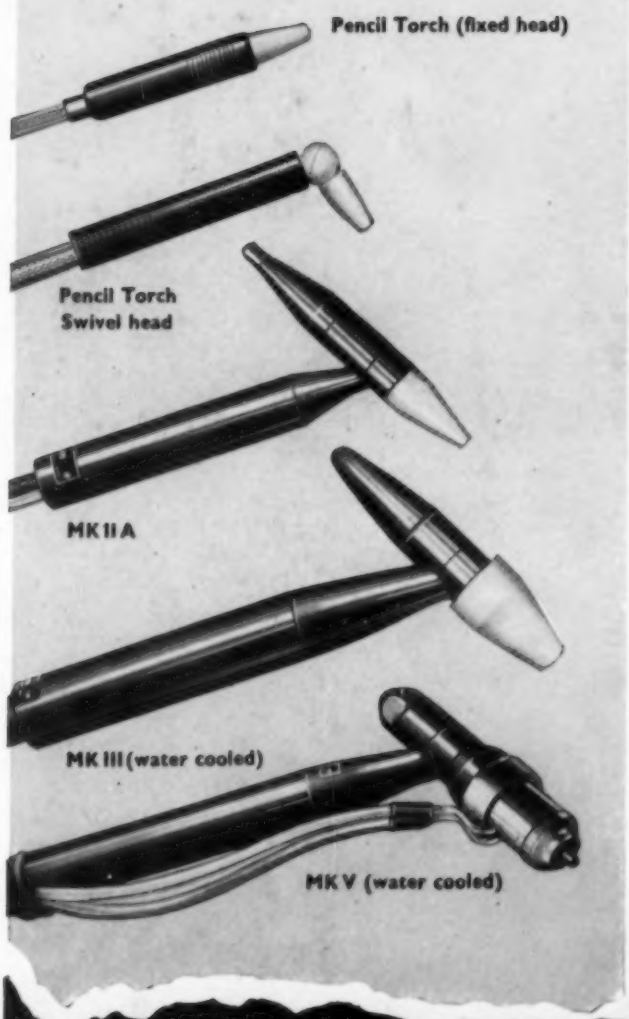

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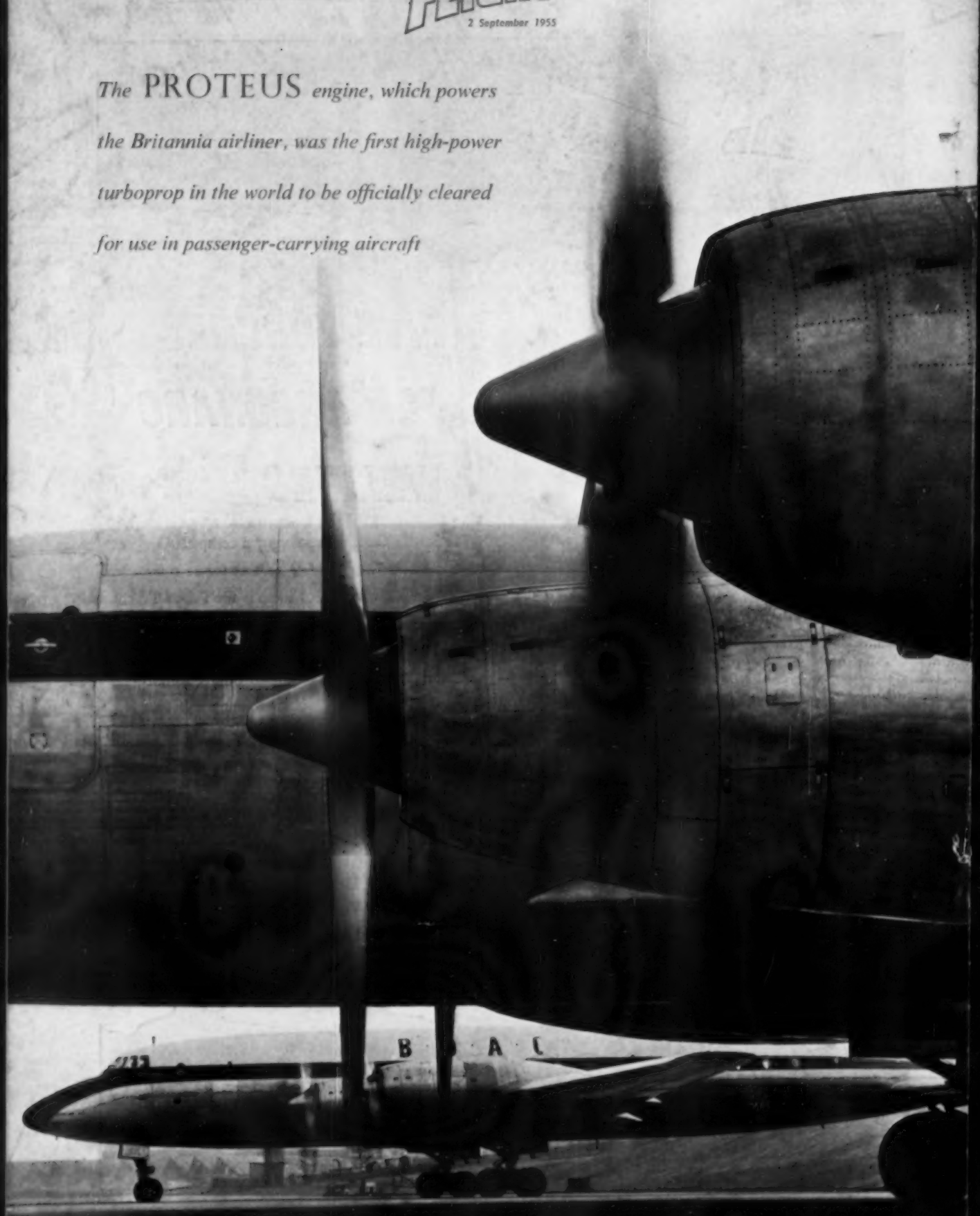

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